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AAES LABORATORY SIMULATOR REQUIREMENTS (A-7 AIRCRAFT).(U)

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AAES LABORATORY SIMULATOR REQUIREMENTS

(A-7 AIRCRAFT)

FINAL REPORT
DECEMBER 1978

By

J. R. Perkins
D. E. Lautner
J. L. Jones
A. J. Marek

For

Naval Air Development Center
Department of the Navy

By

VOUGHT CORPORATION
An LTV Company



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This program was conducted for establishing requirements and developing specific design data for a hot bench mockup (simulator). The simulator system being developed is based on the AAES Prototype Design evolved by the Vought Corporation under contract N62269-75-C-0391. The simulator system will ultimately be used by NADC to provide a laboratory verification of the operation and performance of the AAES in an aircraft weapon system environment. The evolved simulation design is formulated around the TA-7C aircraft.			

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electrical and avionic systems and the general physical/installation constraints of the TA-7C forward and mid fuselage sections. The designs developed under this contract were limited to electrical-avionic system definition and design. Simulator structural, system installation and wire harness designs will be developed under a follow-on contract. The designs developed under this contract include the full application of the AAES technologies to the TA-7C electrical and avionic subsystem and systems. The AAES technologies include HVDC (High Voltage DC) power generation, SOSTEL (Solid State Electric Logic) power distribution and management, and AMUX (Avionic Multiplexing).

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TABLE OF CONTENTS

	PAGE NO.
1.0 INTRODUCTION -----	1
2.0 SYSTEM DESIGN -----	3
2.1 Modular Design Concept -----	3
2.2 TA-7C Subsystem Designs -----	11
2.3 Power Generating System (PGS) Design Requirements -----	11
2.3.1 PGS Definition and Description -----	11
2.3.1.1 Emergency System -----	18
2.3.1.2 External Power -----	18
2.3.1.3 Reverse Current Protection -----	18
2.3.1.4 Bus Controller -----	19
2.3.1.5 Bus Tie Controller -----	19
2.3.1.6 Protective Circuitry and System Coordination -----	19
2.3.1.7 PGS Installation -----	20
2.3.1.8 PGS Equipment Responsibility -----	20
2.3.2 Power Generating System Supplementary Loading -----	20
2.3.2.1 Supplementary Loading Design -----	27
2.3.2.2 Hardware Requirements and Considerations -----	33
2.3.3 Simulator Grounding Requirements -----	33
2.3.4 A-7 Engine Pod Requirements -----	34
2.4 System Control and I/O Interface Requirements -----	34
2.4.1 System Control Equations -----	38
2.4.1.1 Sequential Circuit Implementation Example -----	40
2.4.2 Signal Source Implementation Methods -----	51
2.4.2.1 General Purpose Signal Source Panels -----	51
2.4.2.2 Signal Conditioners -----	51
2.4.3 Load Controllers -----	58
2.4.3.1 Power Output Switches -----	58
2.4.3.2 Lamp Drivers -----	59
2.4.4 Simulator Equipment Utilization -----	59
2.4.5 Load Management -----	62
2.5 Avionic Multiplex System Definition -----	65
2.6 Avionic System Priority Assignment -----	81
REFERENCES -----	88
LIST OF ABBREVIATIONS AND ACRONYMS -----	89
APPENDIX A A-7 Engine Pod Definition for Interfacing HVDC Generator	
APPENDIX B GFE Equipment List	
APPENDIX C Load Management Selection Equations	

LIST OF ILLUSTRATIONS

<u>FIGURE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
1	Modular Concept, Input Control -----	4
2	Modular Concept, Output Control -----	6
3	Liquid Oxygen Gauging System -----	12
4	Emergency Accumulator Test Circuit -----	13
5	AAES Laboratory Simulator PGS -----	17
6	Generator-PCU 270 VDC Feeder Protection Coordination ---	21
7	PCU-LMC 28 VDC Feeder Protection Coordination -----	22
8	PCU-LMC 115 VAC Feeder Protection Coordination -----	23
9	PCU-LMC 115 VAC Feeder Protection Coordination -----	24
10	PCU-LMC 115 VAC Feeder Protection Coordination -----	25
11	Supplementary "Dummy" Load Circuit Diagram -----	28
12	HVDC Supplementary Loading -----	29
13	28 VDC Supplementary Loading -----	30
14	115/200 VAC Supplementary Loading -----	31
15	Supplementary "Dummy" Load Assembly -----	32
16	Simulator Grounding Requirements -----	35
17	20 KVA Generator Gear Box Drawing -----	36
18	Control Stick Assembly -----	53
19	Signal Conditioner Implementation -----	55
20	Load Management Modifier Format -----	63

LIST OF TABLES

<u>TABLE NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
1	TA-7C Subsystem/Circuit Designs -----	14
2	PGS and Bus Network Equipment Requirements -----	26
3	AAES TA-7C Simulator Typical Control Equations -----	37
4	Summary of Memory Requirements and Execution Times for Sequential Equation Solution -----	39
5	Flow Chart Solution for Sequential Circuit -----	42
5a	Flow Chart Solution Using Z-80 Instruction Set -----	44
5b	Flow Chart Solution Using ICU One Bit Processor -----	46
6	Boolean Equation Solution for Sequential Circuit -----	47
6a	Boolean Equation Solution Using Z-80 Instruction Set ---	48
6b	Boolean Equation Solution Using ICU One Bit Processor --	50
7	Comparison of Conversion Approaches -----	52
8	Signal Source Conversion Example -----	54
9	ADM Hardware Utilization -----	60
10	Supplementary Hardware Utilization -----	61
11	Load Management Operating Modes -----	66
12	Avionic Systems Multiplexed -----	67
13	Assignment of Signals to be Multiplexed -----	69
14	AMUX Terminal-Signal Assignments -----	81
15	Equipment Requirements for System Tests -----	82

1.0 INTRODUCTION

The purpose of this program was to establish system requirements and develop specific design data leading to the full development and construction of the AAES TA-7C Simulator. This simulator will in essence be a hot bench mock up of the AAES technologies designed to operate and control the TA-7C electrical and avionic systems. The hot bench mock up configuration, the ADM equipment installation and system interconnect wiring closely simulates an actual TA-7C. Thus it will allow laboratory verification of the AAES technologies in an environment that closely approximates an actual aircraft weapon system.

The work performed under this program consisted of two major items, these being:

- o completing specific design tasks relative to the AAES TA-7C Laboratory Simulator Design and,
- o performing technical services for NADC relative to the AAES development and ADM hardware procurements.

The design tasks included evolving a modular system implementation concept for the simulator; developing system designs, interconnection data and wire diagrams for the TA-7C systems and circuits using the AAES technologies; establishing requirements for system control including a methodology for automatic load management; and identifying the use and requirements for the ADM hardware. The technical services consisted of participating in and assisting NADC in AAES Program and ADM Hardware Development design reviews, assisting NADC in establishing AAES system and hardware requirements, and providing NADC with planning information and data for definition and implementation of the AAES Laboratory Simulator and the AAES Flight Test System.

A modular system design concept for the simulator was developed to allow test and checkout of the complete TA-7C systems and circuits on a "group" basis. A modular design is necessary because the simulator will encompass the full complement of TA-7C systems; however, due to resource limitation, only a partial set of AAES ADM equipment is being developed for the simulator. The modular design developed allows reassignment of the ADM equipment for operating and controlling the TA-7C systems in four functional groups. These four groups are characterized as (1) weapon control and release, (2) flight control, (3) navigation and (4) communications subsystems. Interspersed among these groups are the various airframe utility subsystems. Assignments of the utility subsystems was based on enabling most of the ADM components to be functional during each of the four test configurations. The modular concept therefore provides a realistic simulation of aircraft electrical/electronic system integration as well as intersystem EMI (Electromagnetic Interference) environments. The final aspect of the modular design evolved is that it will allow updating the simulator to a "full-up" system with minimal changes to the basic simulator other than adding the full complement of ADM hardware and incorporating the full-up system operational software.

As an overview, this report identifies the functional areas, systems and circuits of the simulator design which were completed under this contract. The level of design addressed and completed by this program is in the area of the electrical/electronic system and circuit designs. The simulator structure, equipment

installation, and wire harness designs are to be evolved under a subsequent Full Scale Simulator Development Program. The design data and documentation developed under this contract will therefore form the starting base of the Simulator Development Program. The level of design and documentation completed under this program is summarized herein and examples of the data and drawings are provided. The bulk documentation (data and drawings) will be delivered along with the AAES Simulator System.

2.0 SYSTEM DESIGN

Discussed in the following paragraphs are the design tasks performed toward the development of the AAES TA-7C Simulator. Tasks performed include:

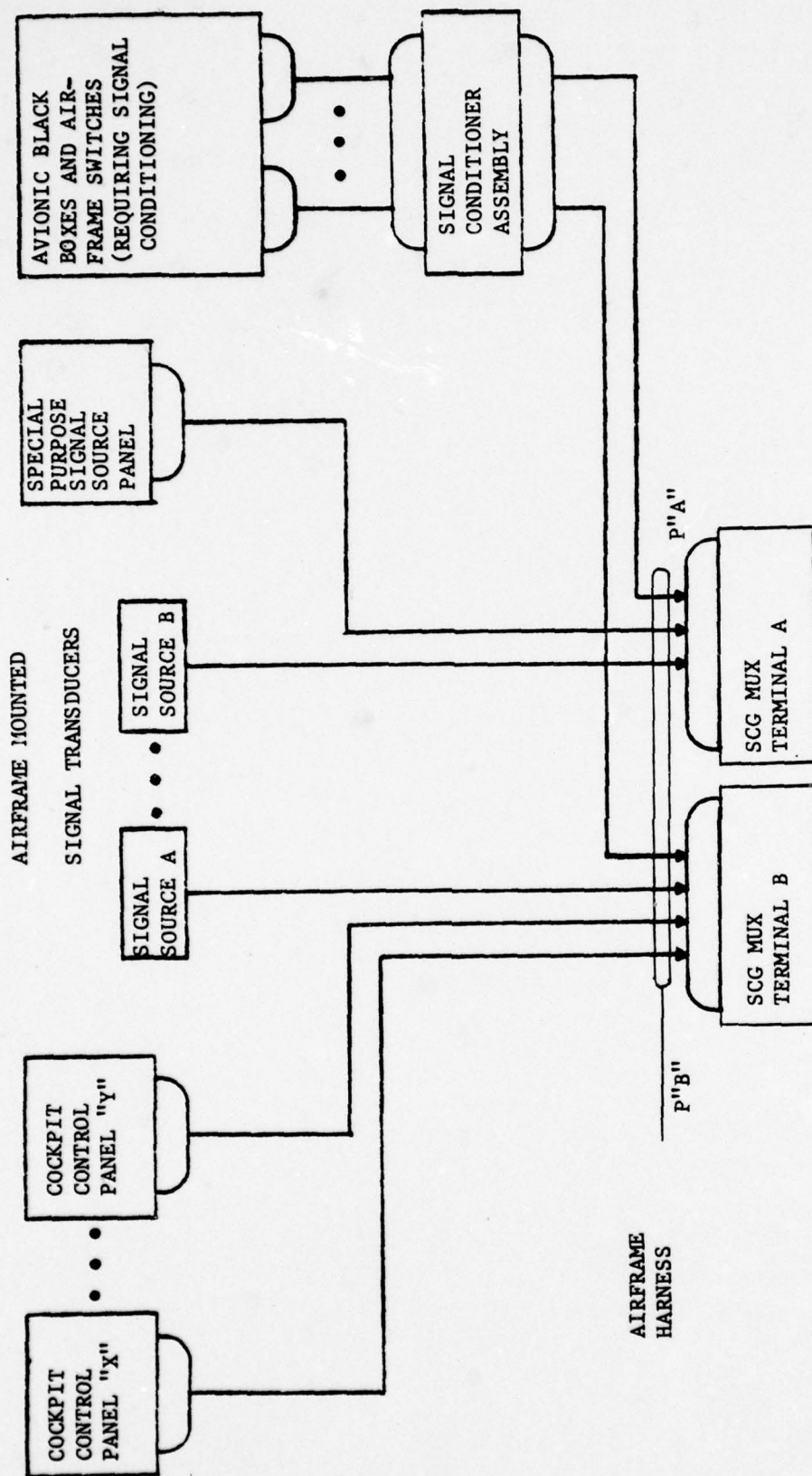
- o Development of modular design concept
- o Design of TA-7C systems, circuits and control panels using AAES concepts
- o Establishment of PGS design requirements
- o Development of system control and I/O interface requirements
- o Establishment of avionic multiplex system scope and requirements
- o Definition of AAES ADM hardware utilization and
- o Establishment of system implementation/checkout priorities

These and related tasks are discussed in the following paragraphs.

2.1 Modular Design Concept

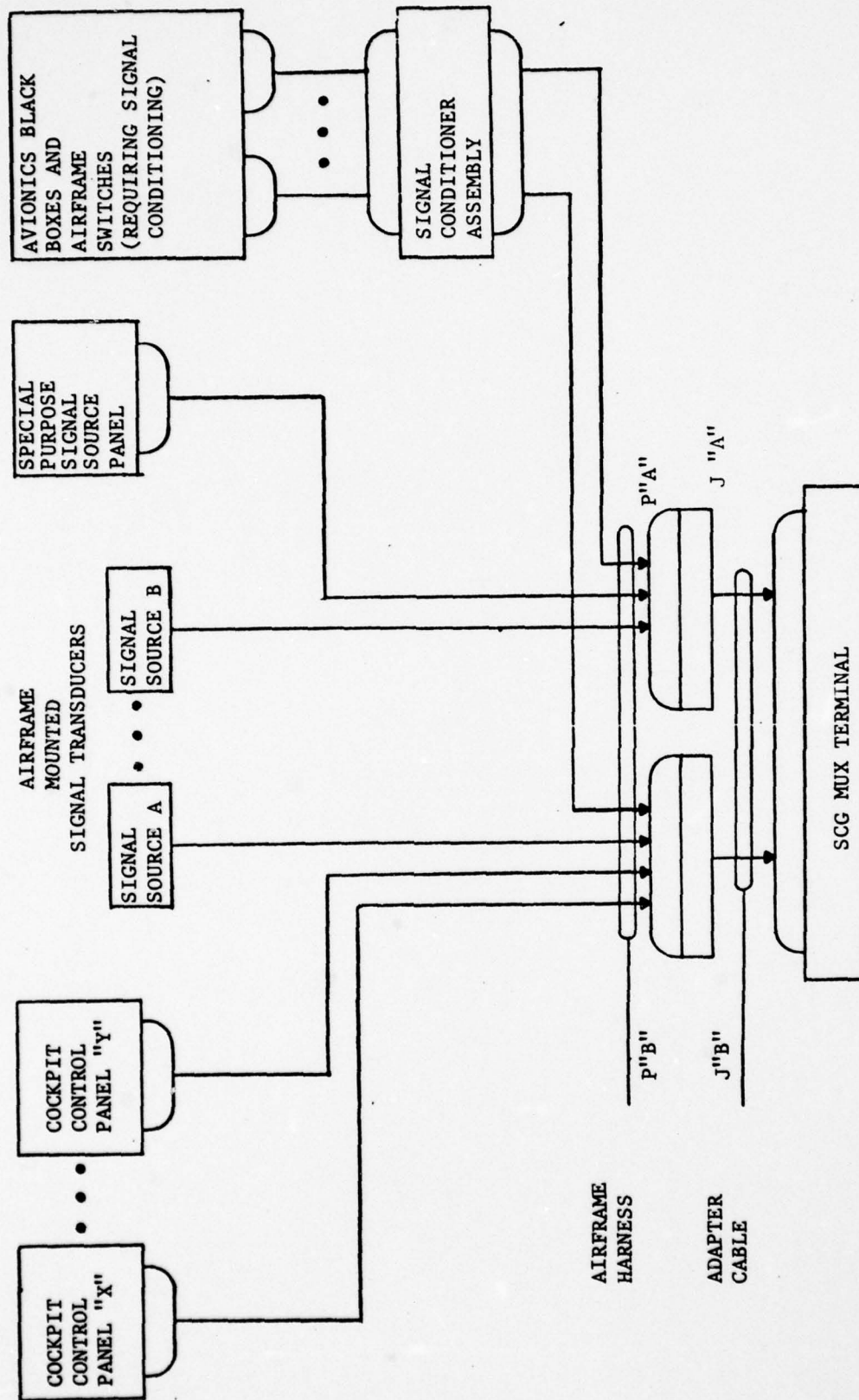
The simulator design is based on allowing operation and checkout of each circuit or subsystem on the TA-7C using a partial set of AAES ADM hardware (approximately 50 percent of that required for a full up system). The design was further evolved based on allowing growth to a full up system with minimal impact to the simulator in terms of design, hardware, wiring and installation details. Based on the ADM hardware available and the specific hardware required to implement the TA-7C Simulator, four checkout groups were established. These functional groups are characterized as weapon control and release, flight control, navigation and communication subsystems. Interspersed among these are the various airframe utility subsystems.

Figures 1 and 2 reflect the basic approach used for accomplishing the modular design. Figure 1 is illustrative of the modular concept in the area of system input control and related interfaces. Figure 1-a illustrates the signal source multiplexer interfaces and associated wire harnesses for a full-up simulator implementation. This interface primarily involves the multiplex terminals, signal sources, signal conditioning, system wiring harnesses, and special adapter cables. Of this equipment, the multiplex terminals and solid state signal sources are being developed (ADM equipment) in limited quantities for application on the simulator. It is expected that the signal sources being developed will not initially be available for installation on the simulator. Therefore, simulated signal sources of the various types needed will be mechanized for the simulator using a "standard" switch with resistors added to achieve the switched impedance function. To complete the input signal category, a full complement of signal conditioning will be provided for interfacing miscellaneous "black box" and "inaccessible" switch function types to the SOSTEL Control Group. As a result, the only input related ADM hardware lacking sufficient quantity for full simulator mechanization is the SCG multiplex terminals. As shown in Figure 1-b, special adapter cables are therefore used to route signals from equipment/circuits to the "available" multiplex terminal. An appropriate set of adapter cables are thus used to select the required set of input signals for each of the four modular checkout groups. Since the multiplex terminal inputs change in terms of signal source function and equation variable for the load to be controlled, a unique set of software is used for each checkout group.



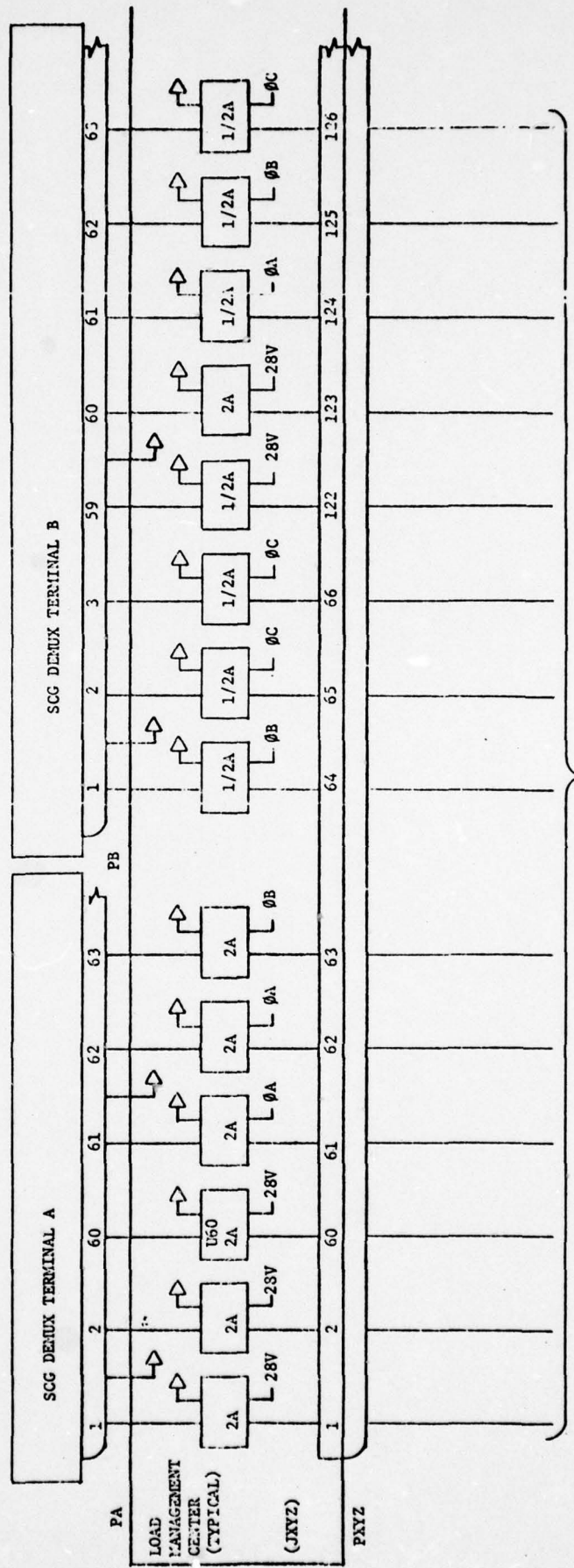
(a) FULL-UP SYSTEM ARRANGEMENT

FIGURE 1 - MODULAR CONCEPT, INPUT CONTROL



(b) CHECKOUT GROUP 1 THROUGH 4 ARRANGEMENT (TYPICAL)

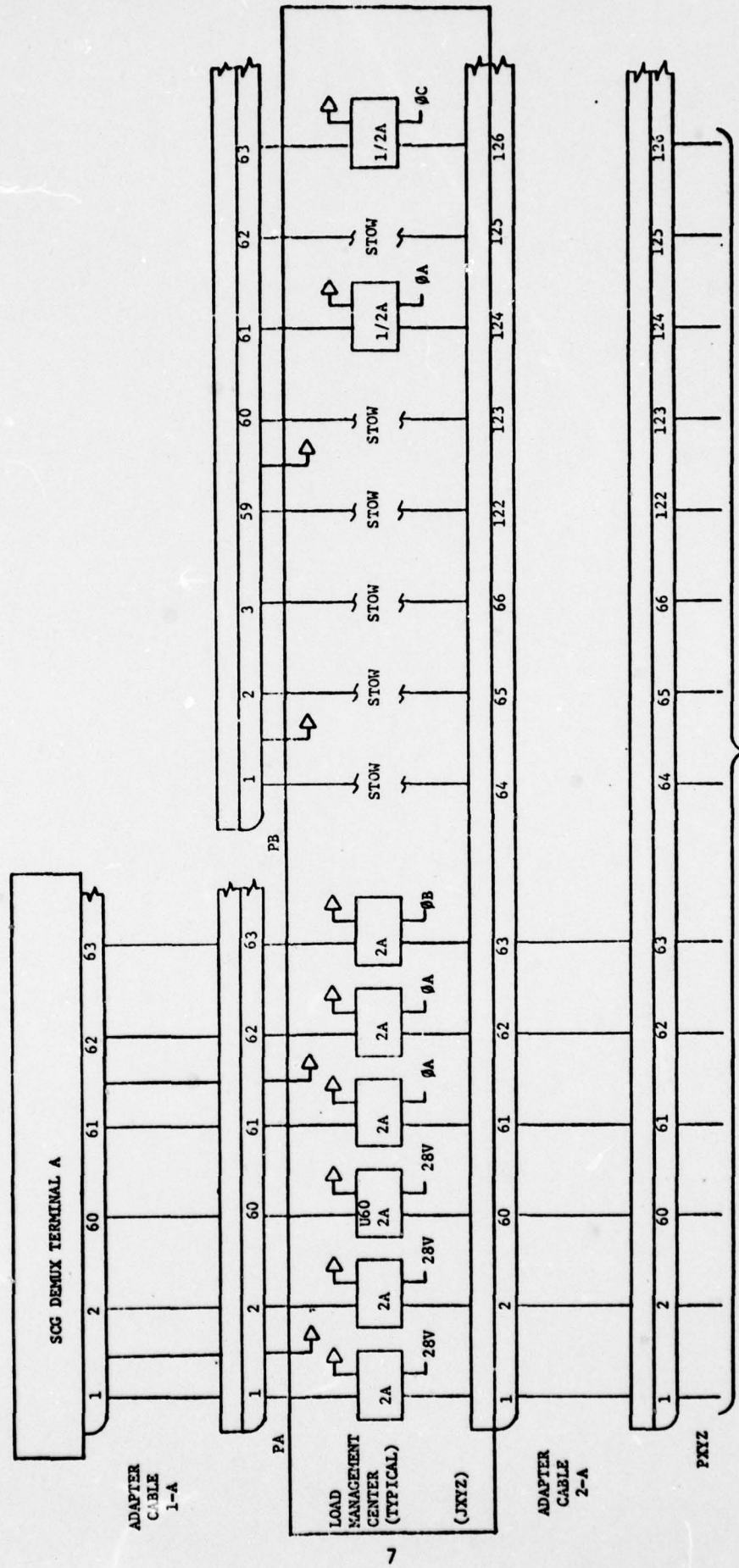
FIGURE 1 - MODULAR CONCEPT, INPUT CONTROL



TO AIRFRAME LOADS

(a) FULL-UP SYSTEM ARRANGEMENT

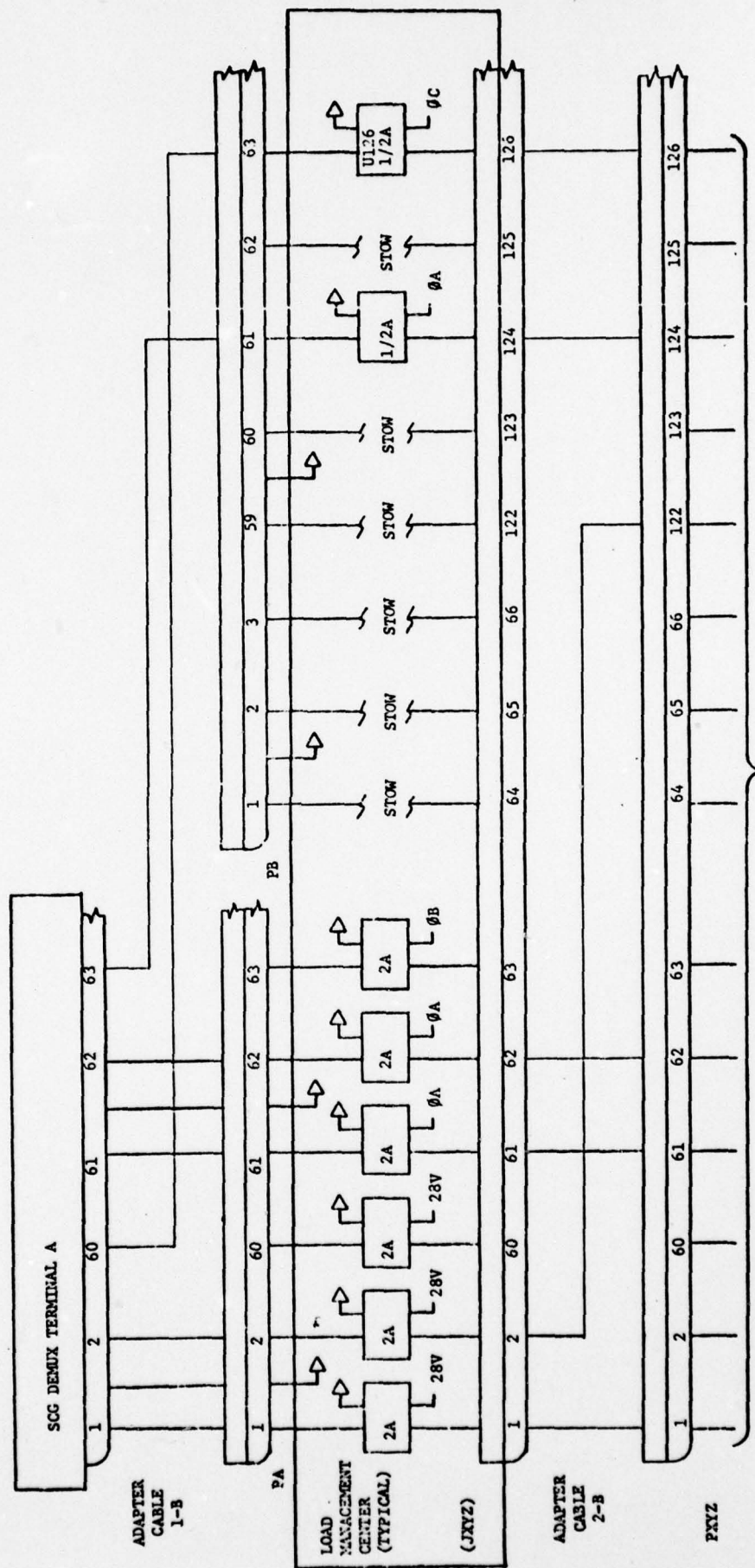
FIGURE 2 - MODULAR CONCEPT, OUTPUT CONTROL



TO AIRFRAME LOADS

(b) CHECKOUT GROUP 1 ARRANGEMENT

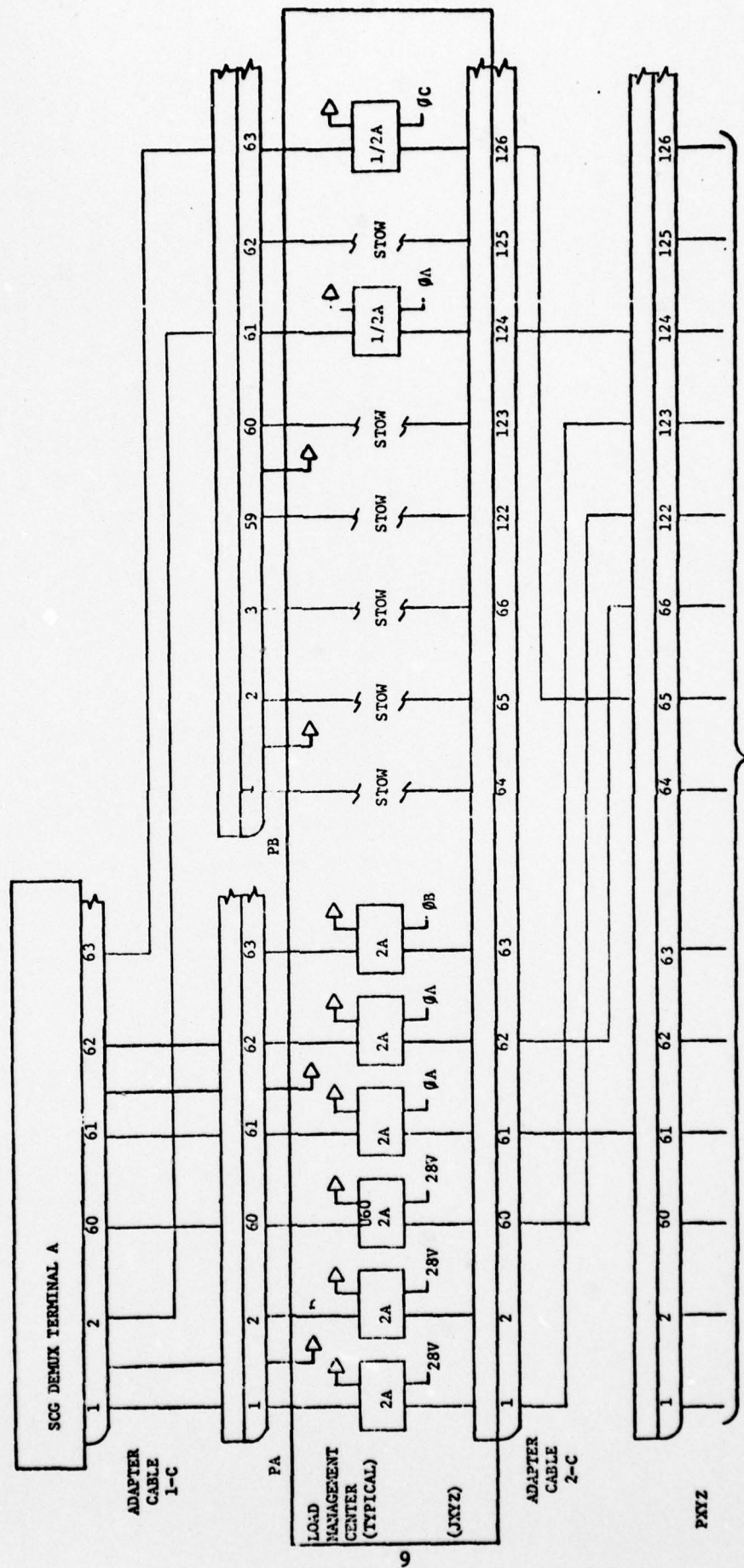
FIGURE 2 - MODULAR CONCEPT, OUTPUT CONTROL



TO AIRFRAME LOADS

(c) CHECKOUT GROUP 2 ARRANGEMENT

FIGURE 2 - MODULAR CONCEPT, OUTPUT CONTROL



TO AIRFRAME LOADS

(d) CHECKOUT GROUP 3 ARRANGEMENT

FIGURE 2 - MODULAR CONCEPT, OUTPUT CONTROL

Figure 2 is illustrative of the modular design as related to the system output control and associated interfaces. Similar to the case described for the multiplex terminals and signal sources, limited quantities of demultiplex terminals and power controllers will be initially available for application on the simulator. One notable difference is that it is not practical to simulate the power controller. Therefore in addition to change out of the "demux to controller" adapter harnesses and software, the power controllers must be reinterfaced to different loads. The controllers are contained in Load Management Centers which are configured as subassemblies for production line producibility. Because of the connector subassembly interface, it is feasible to use adapter cables for establishing the desired controller to load interfaces.

The load controller interface with SCG demultiplex terminals and with the airframe harnessing (and hence airframe loads) is shown in Figure 2-a for the full-up simulator. This figure depicts a typical Load Management Center (LMC) electrical configuration to be used on the full-up simulator. The only difference between this configuration and one which would be used on a production aircraft lies in the demultiplex terminal/load controller interface. In a production configuration, the demultiplex terminal size would be sufficiently smaller (due to MSI/LSI terminal construction) to permit the terminal to be installed within the LMC. Installation within the LMC reduces the control harness length between the demultiplex terminals and the load controllers.

Since the simulator initially will have less controllers and demultiplex terminals than are required for the full-up configuration, adapter cables will be added between (a) the load controllers and the demultiplex terminal, and (b) the load controllers and the airframe harnessing (loads). Figure 2-b through 2-d illustrates these adapter cables. The three figures also show the variation in adapter cables end-to-end terminations. These variations permit limited demultiplex channels to control the "available" load controller complement for powering all simulator loads.

The variation in signal/power paths between checkout groups can be seen by examining the interconnection paths from channel 60 of demultiplex terminal "A". In Figure 2-b (checkout Group 1) channel 60 signal routes through adapter cable 1-A to the input of a 2 ampere, 28 VDC controller. Power is then switched by this controller (designated U60) through adapter cable 2-A to the load associated with airframe harness contact 60 of plug designated P "XYZ". To transition from checkout group 1 to group 2, adapter cables 1-A and 2-A are replaced by cables 1-B and 2-B respectively. This second interconnect configuration (shown in Figure 2-c) permits demultiplex terminal channel 60 to be routed through adapter cable 1-B to a 1/2 ampere, 115 VAC controller (designated U126). Power switched by this controller is routed through adapter cable 2-B to the load associated with P "XYZ" contact 126.

In a similar manner, transitioning from set B switching adapter cables to set C adapter cables reconfigures the LMC to the interface shown in Figure 2-d for checkout group 3. In this group 3 arrangement, channel 60 again controls the 28 VDC, 2 ampere controller designated U60 as occurred in checkout group 1. In group 3, however, U60 controller switches dc power through the 2-c adapter cable to a 28 VDC load associated with P "XYZ" contact 122.

In summary, the modular concept implementation shown for load controllers facilitates sharing the limited output related ADM equipment. However, in addition to load controllers, solid state output drivers are required to provide the full set of SCG output signals. A full set of these output drivers are defined for the simulator system to allow it to be easily expanded to a full-up system. Of particular significance is that this modular checkout concept allows

the simulator basic wiring to remain intact for the full-up case. Also in the interim case, the systems/equipment operated in each of the four functional groups are basically equivalent to those operational at any given time in a full-up system. And lastly, the group assignments result in a maximum usage of the available ADM equipment.

The ADM equipment usage versus that available is described in paragraph 2.4.4 as are the various special equipments (signal conditioners, simulated signal sources and adapter harnesses) needed for the simulator.

2.2 TA-7C Subsystem Designs

A total of 121 TA-7C subsystems and circuits were designed using the AAES technologies, hardware and control techniques. These subsystems are listed in Table 1. Documentation was prepared for the designs using CAD (Computer Aided Design) techniques. Figures 3 and 4 are representative of the designs evolved and the level of completeness and detail contained in the prepared documentation. These representative designs are for the Liquid Oxygen Gauging and the Emergency Accumulator Test systems. The documentation for each system will be expanded to include appropriate harness and termination assignment upon their completion as a part of the Full Simulator Development Program.

2.3 Power Generating System (PGS) Design Requirements

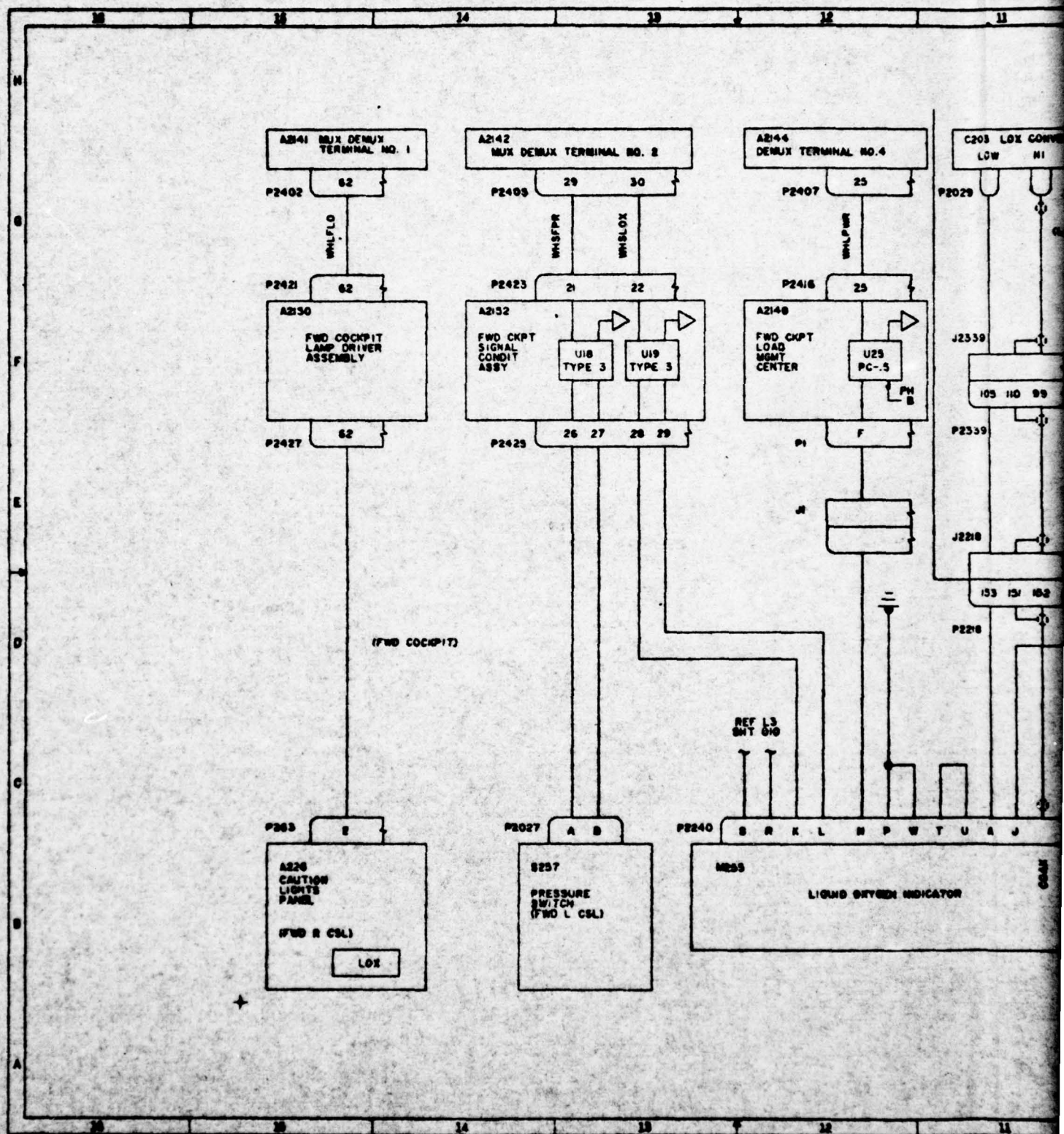
A number of related tasks were performed concerning the PGS. These included preparing a PGS system definition and description, establishing a method for supplementary loading of the ADM 45 KW generator with the simulator system, establishing a preliminary grounding philosophy for the simulator, and defining the A-7 engine pad-generator mounting interface. These are discussed in the subsequent paragraphs.

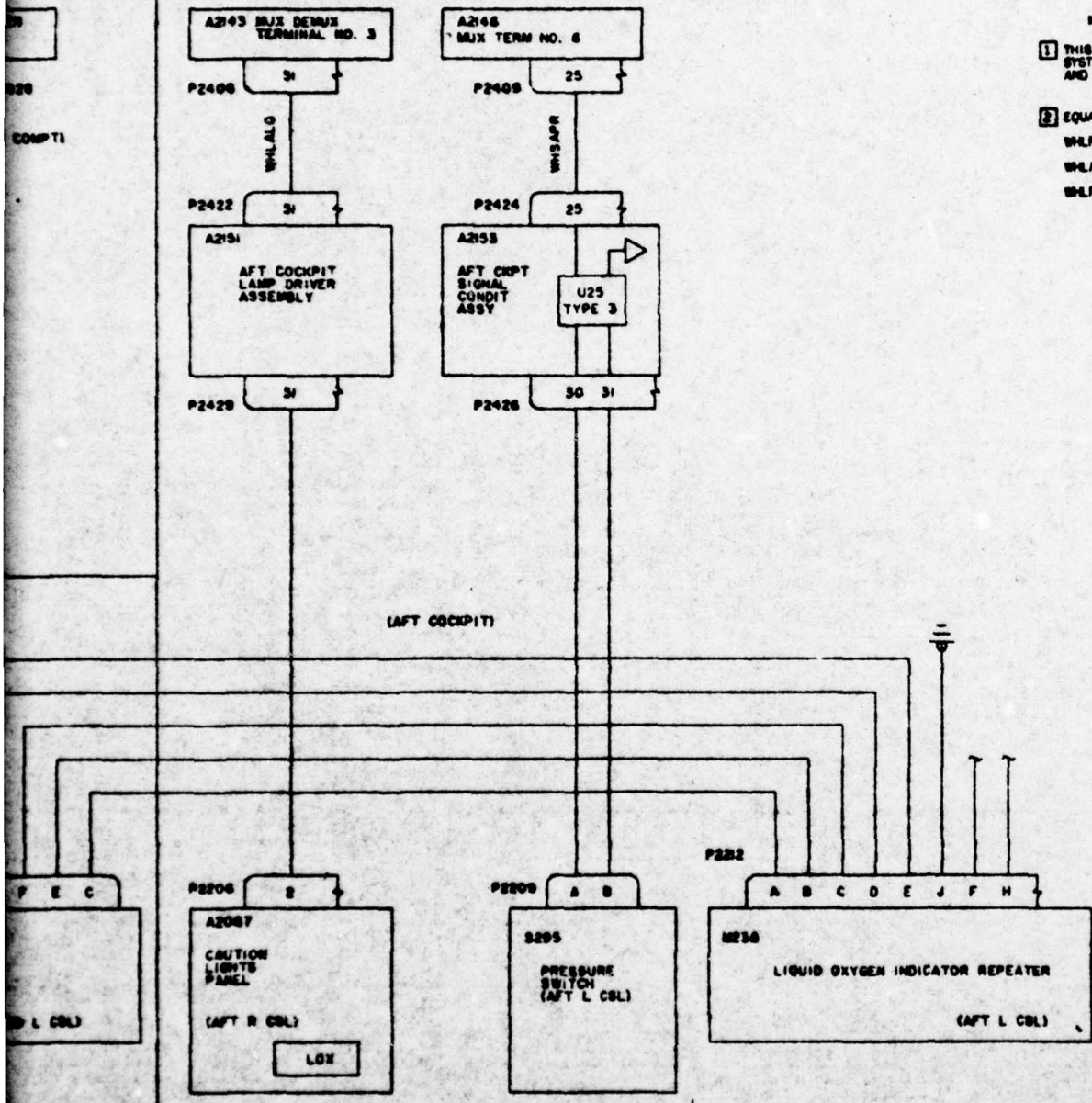
2.3.1 PGS Definition and Description

The power generation subsystem design for the AAES simulator is based upon performance requirements defined in procurement specifications for the generator (NADC-VT-TS-7502 dated 13 June 1975) and the power conditioner units (NADC-VT-TS-7503 dated 8 July 1975). The primary electric power source for the simulator consists of two 45 KW, 270 volt DC generators as defined by the NADC procurement specification. The generators will not be an integral part of the simulator but will be operated from a "generator drive stand" in the NADC AAES Laboratory. Power feeders will route the power to the simulator. The point of regulation will be located on the simulator as will all equipment except the generators. A portion of the 270 VDC power will be used to power 270 VDC "dummy" loads located external to the simulator and a limited number of loads (the SCG and AMUX WRAs) mounted in the simulator. The remainder of the power will be converted to 28 volts DC by two 100 ampere converters and to 115/200 volt AC by two 10 KVA inverters. The generation and conversion equipment will be connected to provide primary buses as shown in Figure 5.

System operation is as follows: When one generator is brought up to rated speed and the output voltage at the point of regulation (located on the simulator) is at rated voltage (270 ± 5 VDC), the HVDC bus controller (BC) and the HVDC bus tie controller (BTC) will automatically close. The generator now

24 x 30
Dwg





NOTES:

1 THIS DIAGRAM IS APPLICABLE TO SYSTEM CHECKOUT GROUPS 1, 2 AND 3.

2 EQUATIONS:

WHLFLO = Z1804

WHLALO = Z1206

WHLPR = 1

NOTES:

1 THIS DIAGRAM IS APPLICABLE TO
SYSTEM CHECKOUT GROUPS 1, 2
AND 3.

2 EQUATIONS:

WLFLO = Z1804

WFLALO = Z1200

WFLPWR = 1

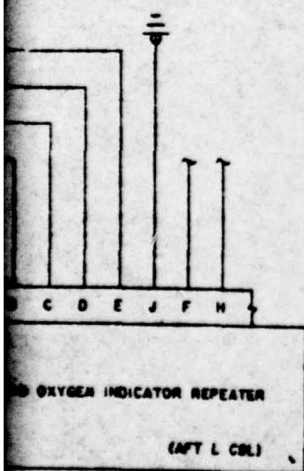
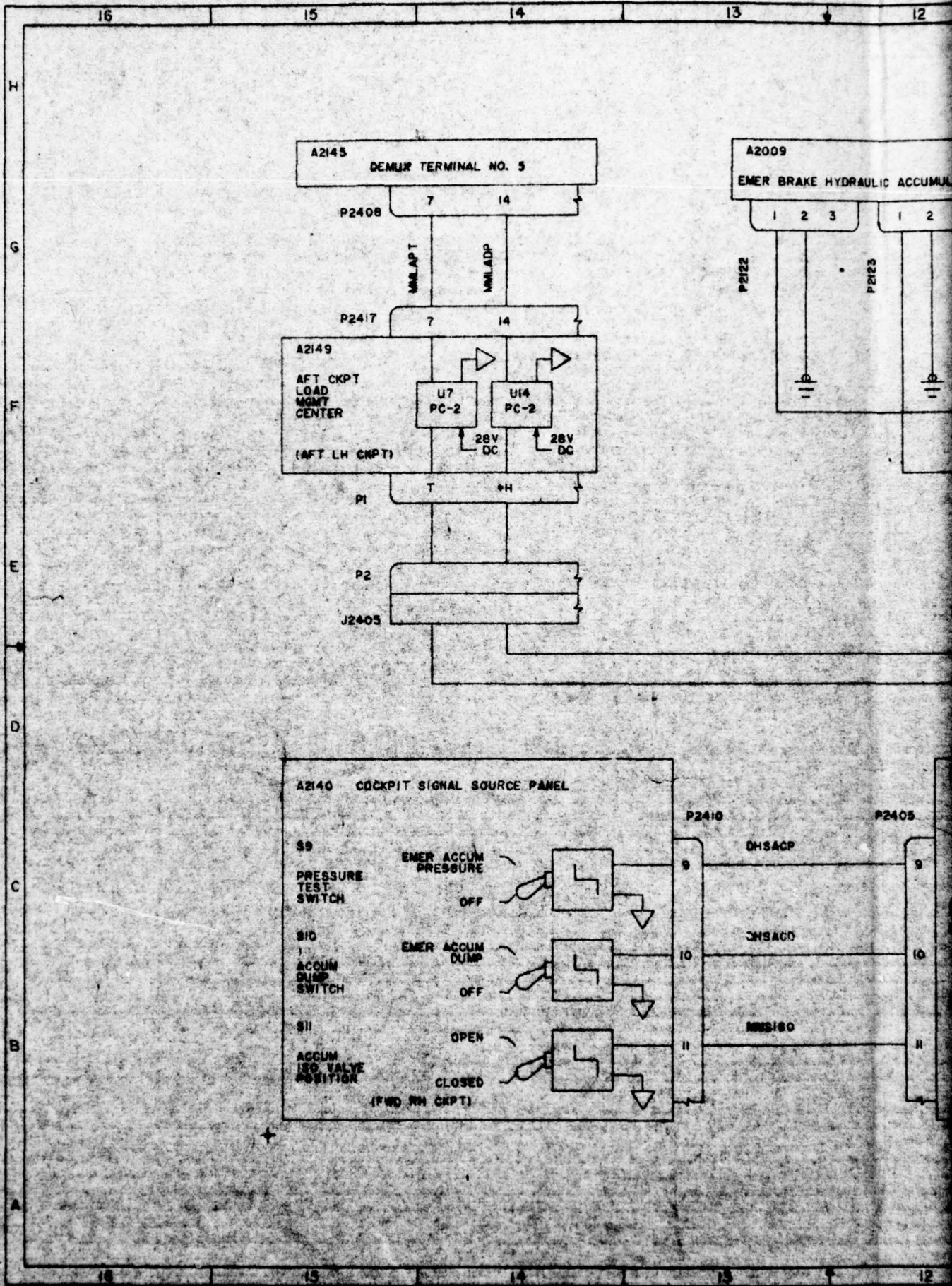
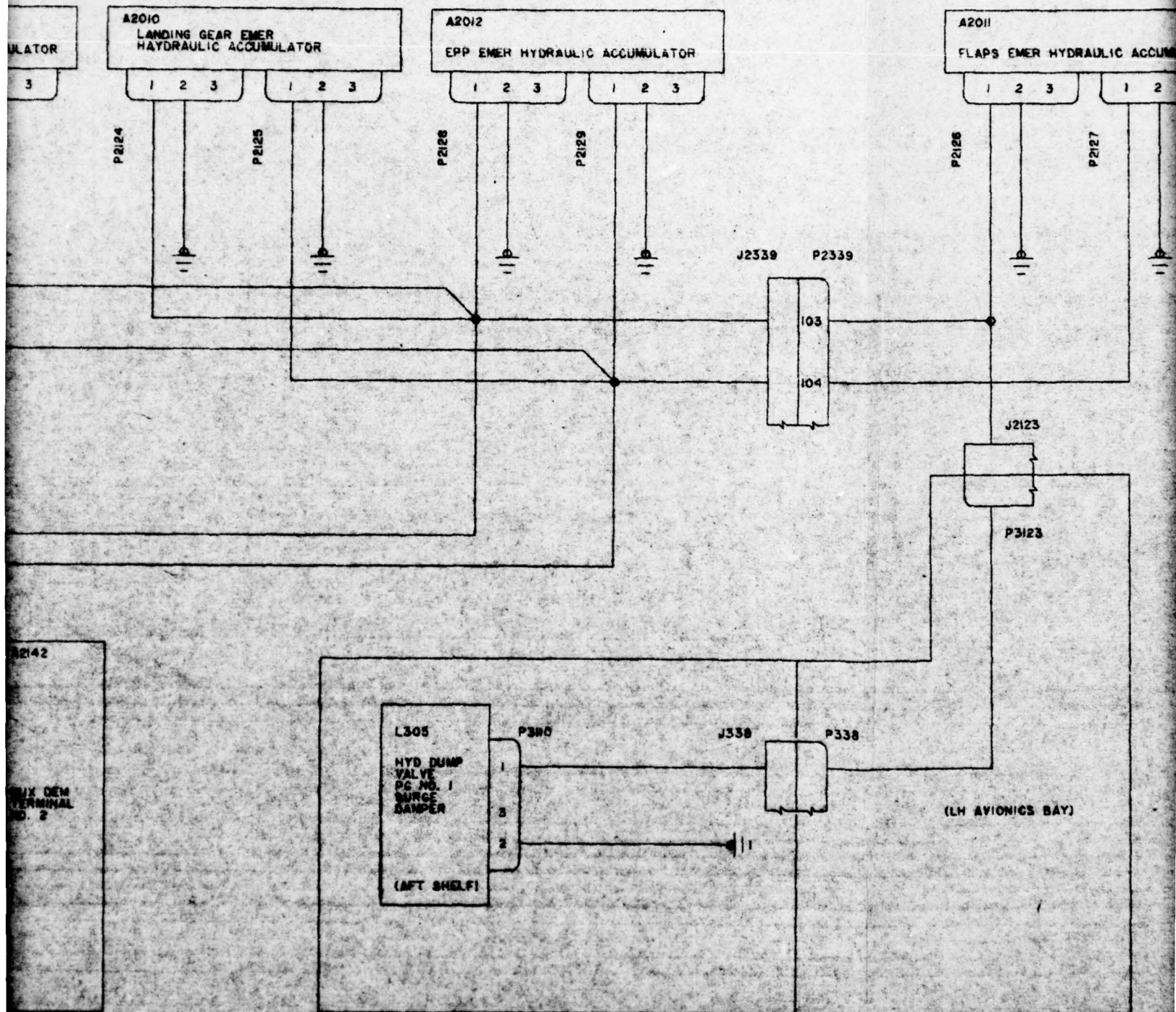


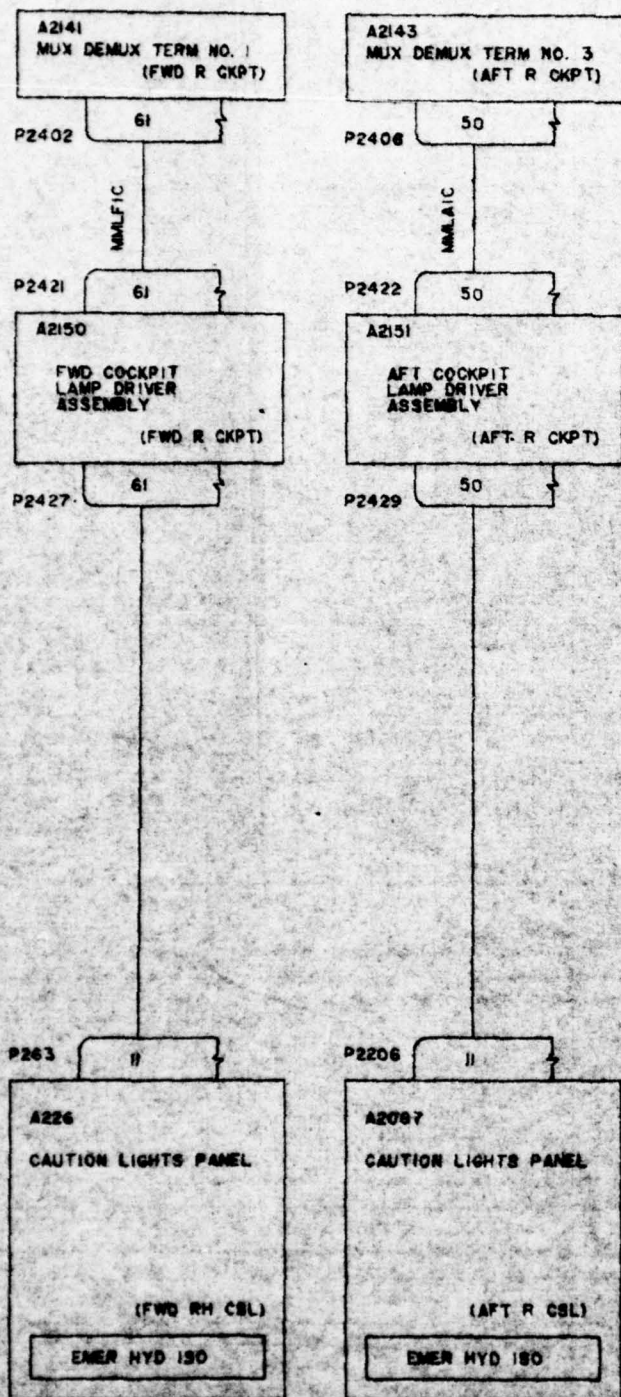
FIGURE 3

NO.	DESCRIPTION	REVISION
1	AXES WIRING DIAGRAM	
2	LIQUID OXYGEN	
3	GAGING	
4	AXES WIRING DIAGRAM	
5	LIQUID OXYGEN	
6	GAGING	
7	AXES WIRING DIAGRAM	
8	LIQUID OXYGEN	
9	GAGING	
10	AXES WIRING DIAGRAM	
11	LIQUID OXYGEN	
12	GAGING	

34 X 88 Q10
2H Q10
DMC 82-80220-WS







NOTES:

1 THIS DIAGRAM IS APPLICABLE TO SYSTEM CHECKOUT GROUP 3.

2 EQUATIONS:

MMALPT = Z1270

MMALADP = Z1271

MMALFIC = Z1272

MMALIC = Z1273

FIGURE 4

NO.	REVISION	DATE	BY	CHKD	APPD
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

**AAES WIRING DIAGRAM
EMERGENCY
ACCUMULATOR TEST**

1115070-10-10330-102

TABLE 1

TA-7C SUBSYSTEM/CIRCUIT DESIGNS

TA-7C SUBSYSTEMS

*A1	Shrike Improved Display System
*A2	Armament Station Control- Jettison
*A3	Weapon Station 1 Stores Management
*A4	Weapon Station 2 Stores Management
*A5	Weapon Station 3 and 4 Stores Management
*A6	Armament Advisory-Forward Cockpit
*A7	M61-Internal Gun System
*A8	Armament Advisory-Aft Cockpit
*A9	Nav/Wpn Del Cmptr-Release Control
*A10	Electric Fuzing System
*A11	Weapon Station 5 and 6 Stores Management
*A12	Weapon Station 7 Stores Management
*A13	Weapon Station 8 Stores Management
B1	KB-18 Camera
C1	Speed Brake Control
C2	Wheels Flaps Warning
C3	Approach Power Compensator
C4	Pitch and Roll Trim System
C5	Automatic Flight Control System- Roll Channel
C6	AFCS-Pitch Channel
C7	AFCS-Yaw Channel
C8	Variable Flaps Control
C9	Emergency Flaps Control
D1	Landing Gear Position Indication
D2	Hydraulic Pressure Indication and Warning
D3	Weight-on-gear and Deck Compression Sensing
D4	Pitch and Roll Trim Indication
D5	Leading Edge Flaps Position Indication
D6	Trailing Edge Flaps Position Indication
D7	Speed Brake Flaps Position Indication
E1	Pressure Ratio Indication
E2	Engine Oil Pressure Indication and Warning
E3	Fuel Quantity Indication and Warning
E5	Engine Fuel Control
E6	Engine Fuel Flowmeter Indication
E7	Fuel Filter Bypass Indication
E8	Turbine Inlet Temperature
F1	Doppler Radar
F2	Pitot Heater/Engine Anti-Icing
F3	Counting Accelerometer System
F4	Standby Attitude Indication
F5	IMS Control
F6	Inertial Measurement Set

(Continued)

TA-7C SUBSYSTEM/CIRCUIT DESIGNS

TA-7C SUBSYSTEMS

F7	Inertial Measurement System
F8	Angle of Attack
F9	Horizontal Situation Indicator
F10	Heading Mode
F11	Flight Mode Control - Fwd. Cockpit
F12	Flight Mode Control - Aft Cockpit
F13	Head Up Display
F14	Projected Map Display
F15	Nav/Weapon Delivery Computer
F16	Nav/Weapon Delivery Computer
F17	HUD Monitor
F18	ARA-63 Approach Control System
F19	HUD & ADI Landing Select Control
F20	Command Transfer Control
F21	Horizontal Situation Indicators
G1	Windfold Control
G2	Landing Gear Safety/Position Detent
G3	Arresting Gear Control
G4	Nose Gear Steering
G5	Launch Bar Control
G6	Anti-Skid Brakes
G7	Parabrake Control
H1	Temperature Control/Rain Repellant
H2	Hydraulic Accumulator Heaters
H3	Electronic Compartment Cooling
K1	Engine Crank and Ignite
K2	Engine Bleed
L1	Flood Lighting-Forward Cockpit
L2	Instrument Board Lighting-Forward Cockpit
L3	Console Lighting-Forward Cockpit
L4	Exterior Lighting
L5	Warning and Advisory Lighting-Forward Cockpit
L6	Flood Lighting-Aft Cockpit
L7	Instrument Board Lighting-Aft Cockpit
L8	Console Lighting-Aft Cockpit
L9	Warning and Advisory Lighting-Aft Cockpit
M1	Seat Adjust
M2	Emergency Accumulator Test
M3	Emergency Power Package Actuator
M4	Canopy Actuation Control and Warning

TABLE 1
(Continued)
TA-7C SUBSYSTEM/CIRCUIT DESIGNS

TA-7C SUBSYSTEMS

*PA1	Primary Power Generation, Conversion and Control
*PB1	External Power Control
*PC1	Primary 270 VDC Load Bus System
*PC2	Emergency 270 VDC Load Bus System
*PC3	Primary 28 VDC Load Bus System
*PC4	Emergency 28 VDC Load Bus System
Q1	In-Flight Refueling and Ground Fueling
Q2	Fuel Transfer and Dump
Q3	Low Level Fuel Warning
*RD1	UHF-ADF System (ARA-50)
*RL1	Auxiliary Radio Receiver Set (ARR-60)
*RN1	TACAN Navigation System (ARN-52)
RP1	ASW-25 Data Link (Display Control)
RP2	ASW-25 Data Link (Forward/Aft Control)
*RU1	UHF Communication System (ARC-51A)
*RZ1	Audio System
*RZ2	Weapon Release and Low Altitude Tone Generator
*SA1	Radar Height Indication System
SN1	Altitude Indicator
SS1	Forward Looking Radar (Dig. Scan Conv.)
SS2	Forward Looking Radar (NWDC Interface)
SS3	Forward Looking Radar (Power Control)
SX1	IFF System (APX-72)
SX2	IFF Aft Control
TE1	Interference Blanker Set
TE2	ALR-50 Radar Homing and Warning
TE3	ALR-45 Radar Homing and Warning
TM1	ALE-29 Chaff Dispenser
TN1	True Airspeed Indicator
TN2	Air Data Computer
TQ1	Radar Beacon (APN-154)
U1-U3	AMUX System
W1	Fire Detection System
W2	Liquid Oxygen Gauging and Warning
W3	Rain Removal Overheat Warning
*XA1	Emergency Power Generation, Conversion and Control
*XB1	Primary AC Load Bus System
*XB2	Emergency AC Load Bus System

* Systems Requiring Additional Circuit Definition and Design which are to be completed on Full Simulation Development contract.

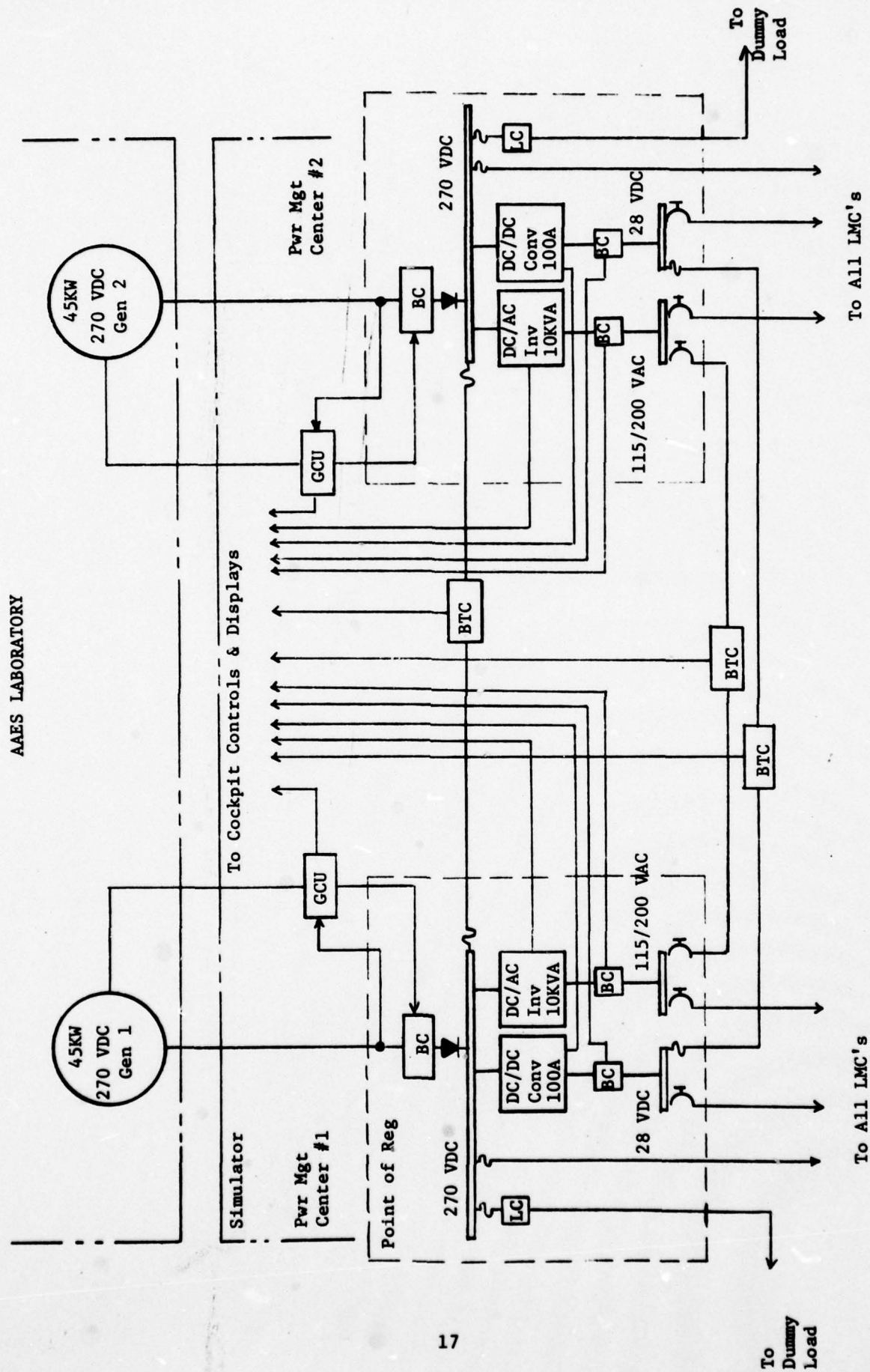


FIGURE 5. AES Laboratory Simulator Power Generation Subsystem

supplies power to both 270 VDC buses. When the other generator is brought up to rated speed and its output voltage is less than 5.0 volts above the main bus voltage, its HVDC bus controller closes automatically and the two generators now supply power to the simulator system loads. The two generators are now operating in parallel which is the normal mode of operation for the system. The main buses are regulated to 270 ± 5 volts DC by each of the generator GCUs which ensures the load on each generator is equally divided. Isolated mode of operation is provided by manually commanding the HVDC BTC to open. In the event a generator becomes inoperative (generator, GCU or drive failure), the failed generator will be automatically disconnected from the bus.

The bus controllers for the converter and inverter are automatically closed (with manual override) when the output voltage characteristics of the inverter and converter are within prescribed limits. The AC bus controller closes when the two inverters are synchronized and voltage levels are within prescribed limits to ensure equal load division. The normal mode of operation for the two converters and inverters is parallel. Isolated mode of operation is provided by manually commanding the 28 VDC BTC and 115/200 VAC BTC to open. The converters and inverters contain overload and fault protection. MIL-STD-704 power at the main buses is maintained by automatic opening of the respective bus controller should MIL-STD-704 limits be exceeded.

It is noted that all control of power to the main buses is independent of SOSTEL. Data, however, can be supplied to SOSTEL to effect the control of loads (i.e., load management) by SOSTEL. Useful data includes generator temperature, converter temperature, inverter temperature, bus voltage (270 VDC, 28 VDC, 115/200 VAC), AC bus frequency and ripple content on DC buses. SOSTEL can be programmed to remove loads when data indicates the removal of loads might avert shutdown of the complete system.

2.3.1.1 Emergency System

An emergency power source as defined by SD-24K is not provided. The emergency operation will be simulated by having one generator operate as the primary source and the other generator serve as an emergency source. The non-essential loads will be removed from the buses via SOSTEL control during the simulated emergency condition.

2.3.1.2 External Power

The Vought AAES Simulator Design is presently based on not including "External Power" provisions. In the event that NADC wants "external power" provisions included on the simulator, this requirement should be established prior to award of the simulator development contract. Design data and interface requirements for the power monitor, external power receptacle and bus controller hardware must be established by NADC to enable adequate design of the External Power interface on the simulator if required.

2.3.1.3 Bus Controller

The bus controller function can be implemented with either an electro-mechanical, solid state or hybrid (electromechanical and solid state) device. The DC bus controller can be either a directional or a bi-directional device. If it is a directional device, it must have reverse voltage blocking capability. The controller must be capable of conducting and switching the maximum power source output current without affecting the normal operation of the power source protective circuitry. That is, the bus controller must not impede the flow of current. The minimum current level is 150 percent of generator rating for the inverter and converter bus controllers (specification NADC-VT-TS-7503 dated 8 July 1975). The HVDC bus controller must also have a minimum blocking voltage rating of 500 VDC. The Hartman contactor, part no. A-751RG, meets the HVDC bus controller requirements for the laboratory environment. Vought will establish the installation and connection requirements for the converter and inverter bus controller based on the Hartman contactor unless notified to the contrary by NADC prior to award of the Simulator Development Contract.

2.3.1.4 Bus Tie Controller

The bus tie function can be implemented with an electromechanical, solid state or a hybrid device. The DC devices must be capable of conducting and switching bi-directional current. Bus tie controllers must be compatible with the opening characteristics of feeder protectors (fuses or circuit breakers), that is, it must not impede the flow of current to the extent that the protector will not open. The Hartman bus tie controller, part no. A-751RG, meets the HVDC bus tie requirements for the laboratory environment. The AAES simulator designs, installation and electrical interface will be based on this device unless Vought is advised to the contrary prior to award of the Simulator Development Contract.

2.3.1.5 Protective Circuitry and System Coordination

To provide compatibility with the power source (generator, converter, inverter) equipment, it is necessary that the feeder protector opening characteristics (fuse or circuit breaker) not cause interference with the normal operation of the power source protective circuitry i.e., the feeder protector device must open before the power source trips off the bus. System design requires the capability of supplying full system load from either generator. Therefore, the HVDC bus tie feeder and associated feeder protectors must be rated for 100% generator capacity. This creates a problem because the trip characteristics of available feeder protectors (high voltage fuses) can allow the generator to trip before the feeder protector opens, i.e., clears the fault. This results in the generator protecting the feeder in some load conditions rather than the fuse providing the feeder protection.

Additionally, available feeder protectors that are needed for protecting feeders to some of the LMCs are not compatible with the converter and/or inverter protective circuitry. That is, the LMC feeder protector (fuse or circuit breaker) can allow the converter and/or inverter to trip before the feeder protector opens. These problems are primarily due to the tight trip limits established for the generator, converter and inverter. This is not a serious problem for the simulator since feeder faults will be an unlikely occurrence due to the simulator environment. Should a feeder fault occur, the worst thing that could happen would be a nuisance power source (generator, converter or inverter) trip. Vought will therefore select feeder protectors based upon feeder current ratings. Possible solutions exist for actual aircraft applications which include changing the power source trip limits, or paralleling feeders to allow use of current protectors that have lower trip ratings.

The generator, power converter, feeder protector coordination conditions as they exist for the AAES TA-7C Simulator are highlighted in Figures 6 through 10. Figure 6 identifies the trip coordination for the generator 270 VDC protection and the PCU feeder protector. This shows that the generator will trip off-line rather than the fuse opening to isolate PCU feeder faults for overload conditions in excess of 120 percent of generator rating, i.e., 200 amperes. Also shown is the compatibility between the generator with respect to the TA-7C composite overload as imposed by an overloaded PCU. Figure 7 indicates the incompatibility between the PCU trip protection and the worst case LMC feeder circuit breaker. In this case the PCU will trip rather than the circuit breaker for 28 VDC overloads exceeding 150 amperes. Also the PCU will not carry the full simulator composite load under a feeder fault condition. The PCU will, however, marginally carry the full simulator 28 VDC composite load under normal conditions. Figures 8, 9 and 10 indicate the coordination conditions for 115 VAC for cases of using MIL-C-5809 circuit breakers, MIL-F-5372 fuses and MIL-F-15160 fuses, respectively. Proper coordination is obtained using the circuit breaker and the 5372 fuse. The 15160 fuse is not compatible with the PCU trip protection limits.

2.3.1.6 PGS Installation

The bus controllers, inverter, converter and feeder protectors will be installed in close proximity to each other and physically protected to form a "power management center" as shown in Figure 5. This will negate the need for feeder protectors between the HVDC bus and the inverter/converter. Detailed installation data/design will be generated as part of the Full Simulator Development contract.

2.3.1.7 PGS Equipment Responsibility

The power generation and bus network equipment requirements for the AAES simulator are summarized in Table 2. Identified are equipment types, quantities, and procurement responsibility as presently understood by Vought.

2.3.2 PGS Supplementary Loading

The HVDC generator and power converter/inverter equipment procured for the simulator requires supplementary loading in order to provide equipment evaluation at full capacity. This is required because limited ADM equipment is being initially procured and the TA-7C electrical load is less than the ADM generator 45 KW rating.

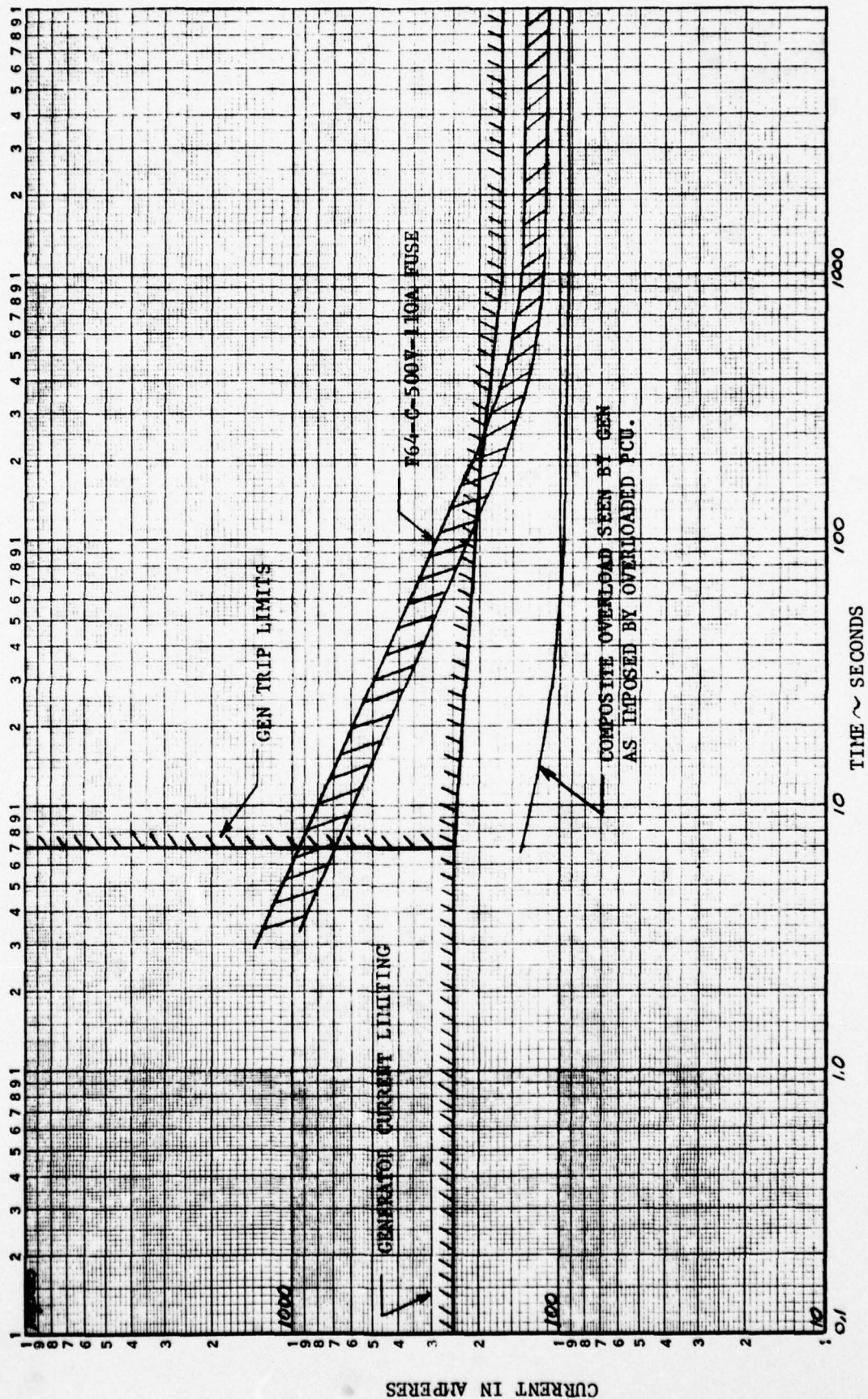


FIGURE 6 GENERATOR-PCU 270 VDC FEEDER PROTECTION COORDINATION
(MIL-F-15160 FUSES)

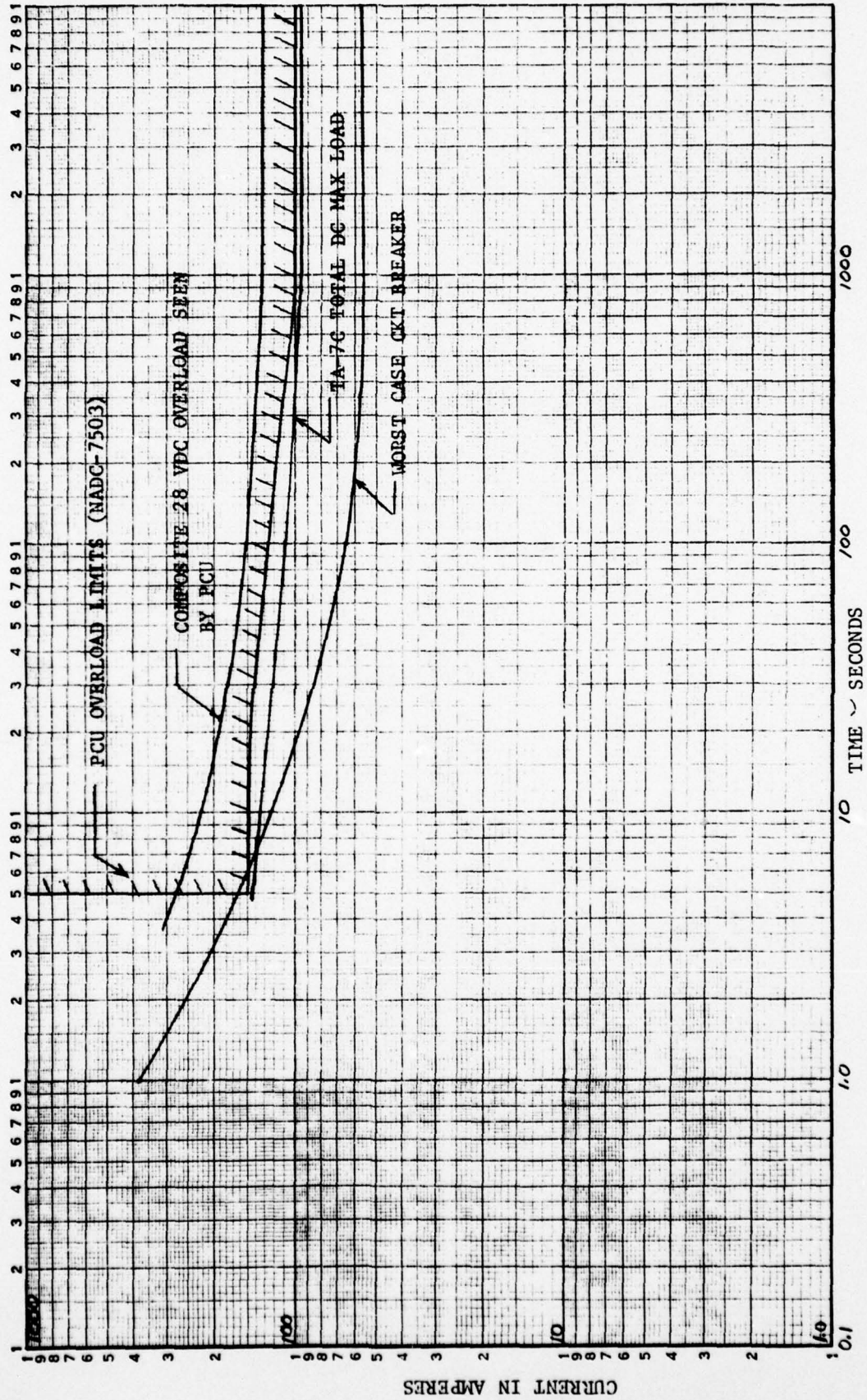


FIGURE 7 PCU-IMC 28 VDC FEEDER PROTECTION COORDINATION
 (MIL-C-27715 CIRCUIT BREAKERS)

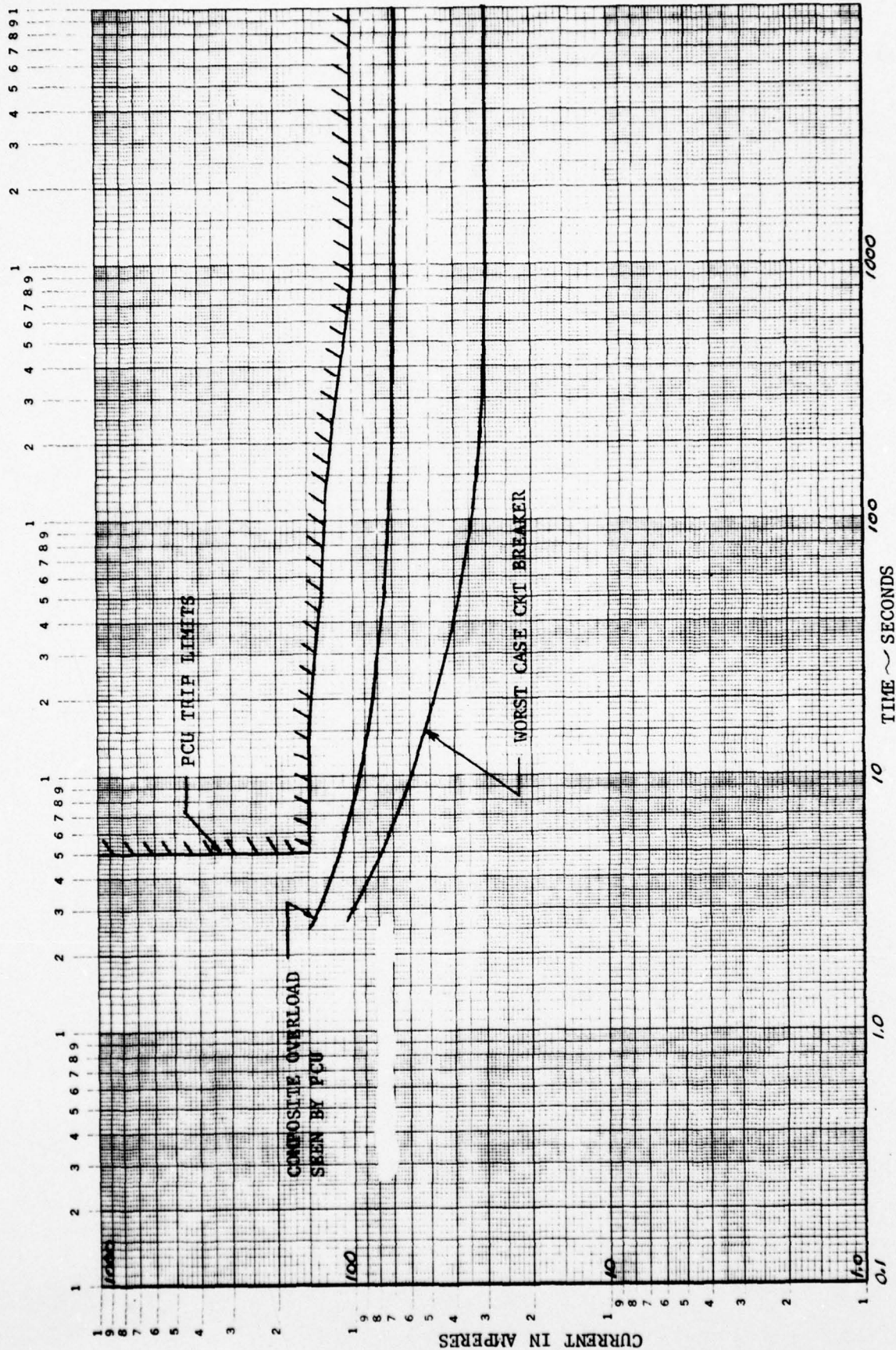


FIGURE 8 PCU-LMC 115 VAC FEEDER PROTECTION COORDINATION
(MIL-C-5809 CIRCUIT BREAKERS)

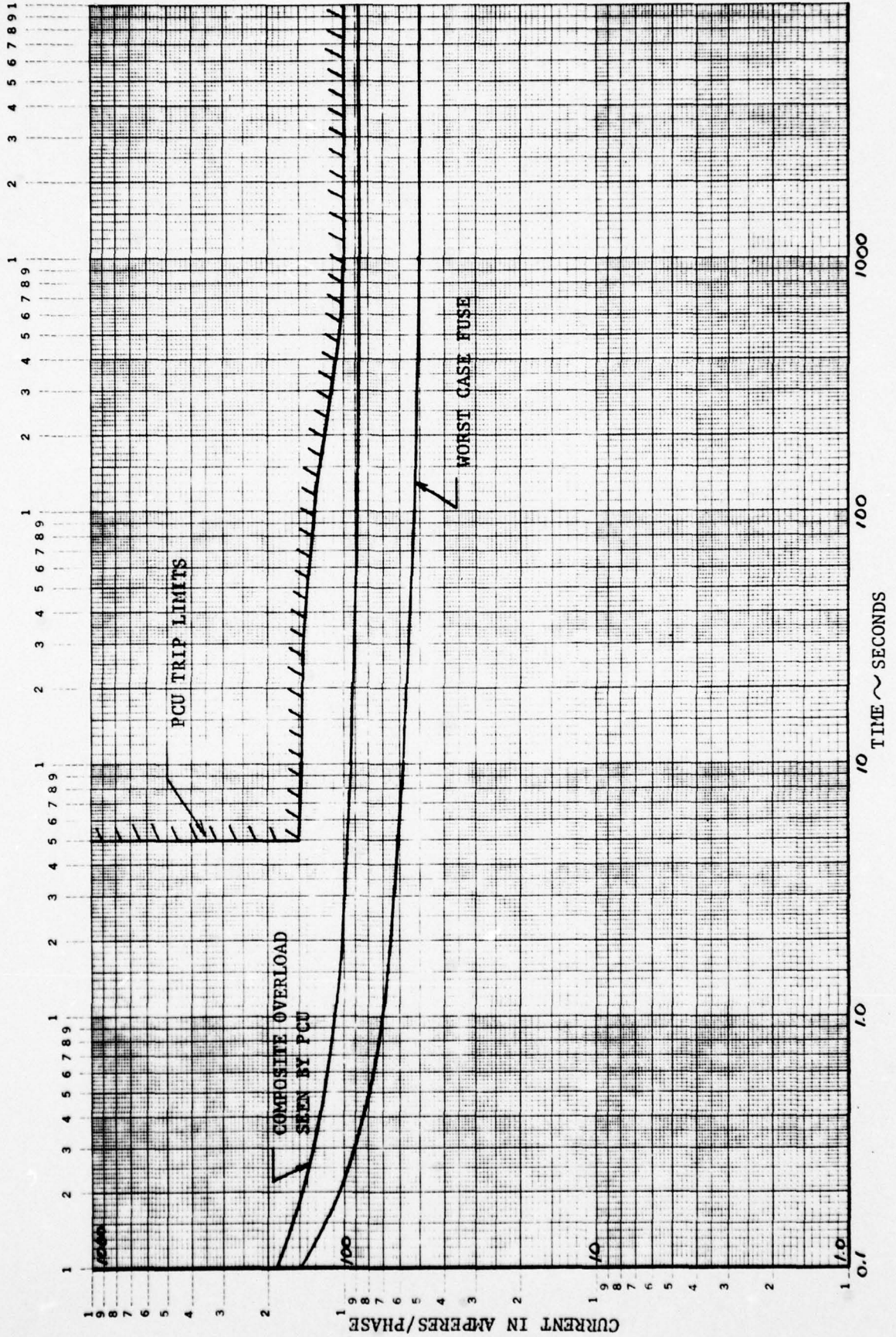


FIGURE 9 PCU-LMC 115 VAC FEEDER PROTECTION COORDINATION
(MIL-F-5372 FEEDER PROTECTORS)

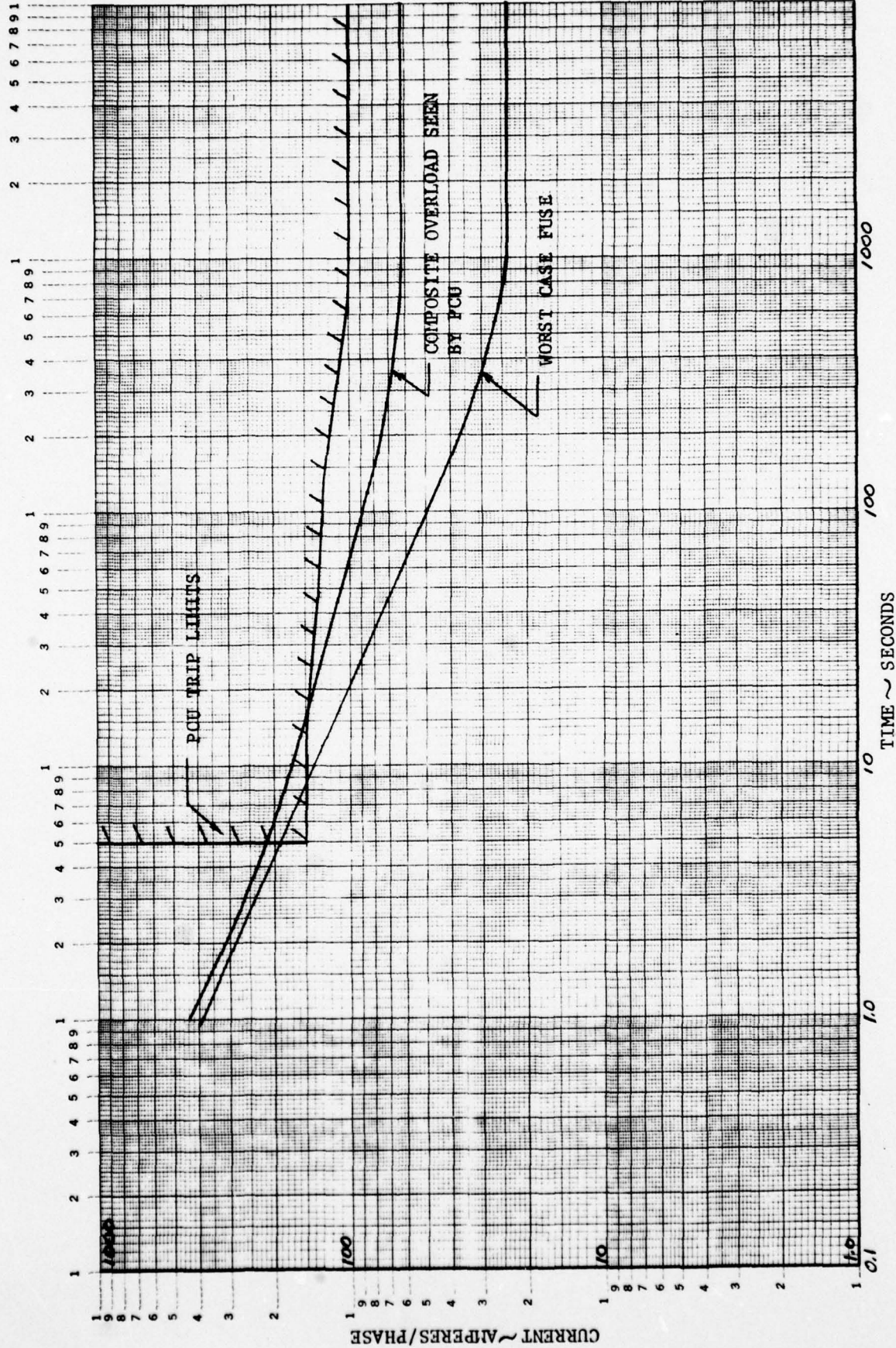


FIGURE 10 PCU-IMC FEEDER PROTECTION COORDINATION
(MIL-F-15160 FEEDER PROTECTORS)

TABLE 2.

POWER GENERATION SUBSYSTEM AND
BUS NETWORK EQUIPMENT REQUIREMENTS

<u>ITEM</u>	<u>NOMENCLATURE</u>	<u>PART NO.</u>	<u>QTY</u>	<u>FURNISHED BY</u>
1	45KW, 270VDC Generator Sys	NADC-VT-TS-7502	2	NADC
2	100A, 28VDC Pwr Conditioner	NADC-VT-TS-7503	2	NADC
3	200A, 270VDC Bus Controller	A-751RG or Equiv	2	NADC
4	200A, 270VDC Bus Tie Controller	A-751RG or Equiv	1	NADC
5	100A, 270VDC Load Controller	A-754R or Equiv	8	NADC
6	HVDC Feeder Fuse	Type F64-C-500	24	Vought
7	100A, 28VDC Bus Controller	MS24141-D1 or Equiv	2	NADC
8	50A, 115/200 VAC Bus Controller	MS24168-D1 or Equiv	2	NADC
9	100A, 28VDC Bus Tie Contr	MS24141-D1 or Equiv	1	NADC
10	50A, 115/200VAC Bus Tie Contr	MS24168-D1 or Equiv	1	NADC
11	28VDC Feeder Fuse	MS28937-XXXX	2	Vought
12	28VDC Feeder Circuit Bkrs	MS24571-XXXX	14	Vought
13	115/200 VAC Feeder Circuit Bkrs	MS14153-XXXX	16	Vought
14	Cockpit Controls & Displays	TBD	-	Vought
15	10KVA, 115/200VAC Pwr Cond.	NADC-VT-TS- 7503	2	NADC
16	Diodes, Reverse Current Protection	TBD	2	Vought

External Power Provisions if Required

17	External Power Receptacle	TBD	1	NADC
18	External Power Monitor	TBD	1	NADC
19	200A, 270VDC Bus Controller	A-751RG, or Equiv	1	NADC
20	Diode, Reverse Current Protection	TBD	1	Vought

The discussion which follows describes a recommended design for artificially loading the AES simulator power system.

2.3.2.1 Supplementary Loading Design

Design provisions for artificial (or dummy) loads are provided on the simulator to allow the power system capacity to be fully exercised. These loads are connected to the main power buses (270 VDC, 28 VDC and 115/200 VAC) through electromechanical contactors. The contactors are controlled by the SCG terminal located in the aft equipment shelf LMC.

Figure 11 provides a block diagram overview of the dummy load circuitry. Figures 12 through 14 depict the load interconnection at each main bus and identify the recommended hardware and load current requirements. The figures also show the division between simulator installed hardware and provisions versus external simulator hardware.

As shown in the figures, the contactors are controlled by the SCG via relay drivers. Ideally, this relay driver function would be provided by ADM load controllers. However, due to the limited initial load controller quantities being procured for the simulator, the contactors may be energized by solid state custom designed relay drivers controlled by an SCG terminal. The estimated load requirements for these drivers are:

3.5 amperes at 28 VDC for 500 milliseconds
0.4 amperes at 28 VDC continuously

Provisions are included in the design to allow connection of the dummy loads to the main power buses via SCG control. The dummy load control via the SCG will be derived by:

- o The state of various signal sources installed in the General Purpose Signal Source Panel located on the aft equipment shelf
- o The operational mode of SCG Load Management system software routine.

This method of control permits dummy loading of the power system by manual (signal source panel) or automatic (load management) operations. The Boolean logic for this control will be integrated into the power distribution software of the SCG Processors to be delivered by Vought with the simulator.

As shown in Figures 12 through 14, a total dummy load requirement of 135 to 270 kilowatts is required to adequately evaluate the simulator power system. Since the required mounting space for the dummy loads is somewhat excessive, mounting of dummy loads external to the simulator is recommended. In addition, to keep the simulator relatively "clean" of power system "test" hardware, the power contactors and wire harnessing associated with dummy load control should also be located in mounting racks located external to the simulator. Figure 15 schematically depicts this external rack configuration. It is anticipated that existing generator load banks at NADC can be used for the dummy loads to reduce hardware costs.

Interconnection points are provided on the simulator for interfacing the load rack (Figure 15) to the main power buses and to the appropriate SCG demultiplex terminal channels. The power bus terminations (identified as Point A in Figures 12 through 14) are downstream of the feeder protectors but within the associated Main Power Center to maintain physical protection of the power bus.

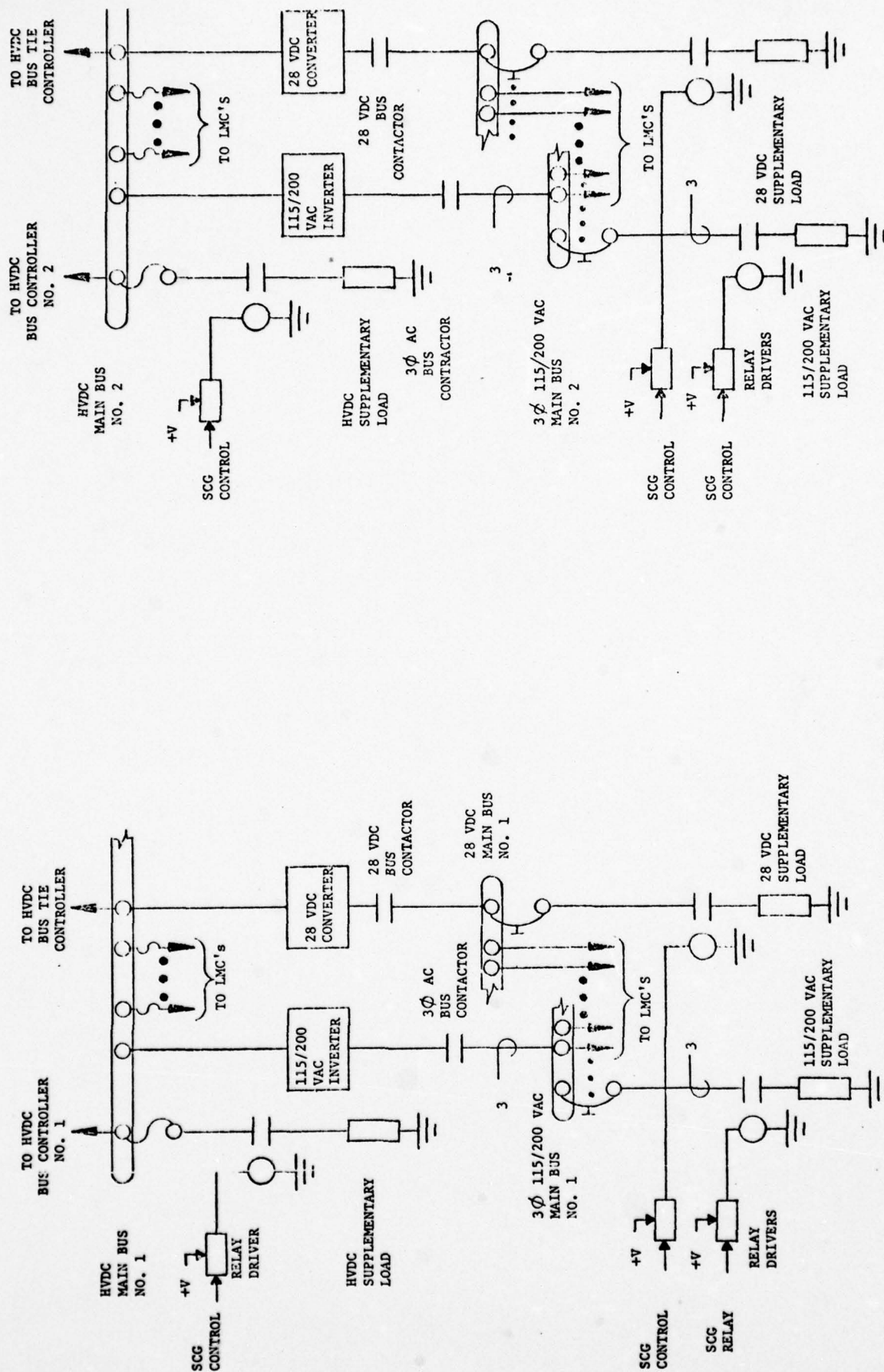


FIGURE 11 - SUPPLEMENTARY LOAD CIRCUITRY - BLOCK DIAGRAM

HARDWARE LIST

REF DES	DESCRIPTION	PART NO.
F1	FUSE	F63-C-500-701
F2	FUSE	F63-C-500-701
F3	FUSE	F63-C-500-701
F4	FUSE	F63-C-500-701
K1	CONTACTOR	A-754R (HARTMAN)
K2	CONTACTOR	A-754R (HARTMAN)
K3	CONTACTOR	A-754R (HARTMAN)
K4	CONTACTOR	A-754R (HARTMAN)
	RELAY DRIVERS	TBD

270 VDC
MAIN BUS
NO. 1 OR 2

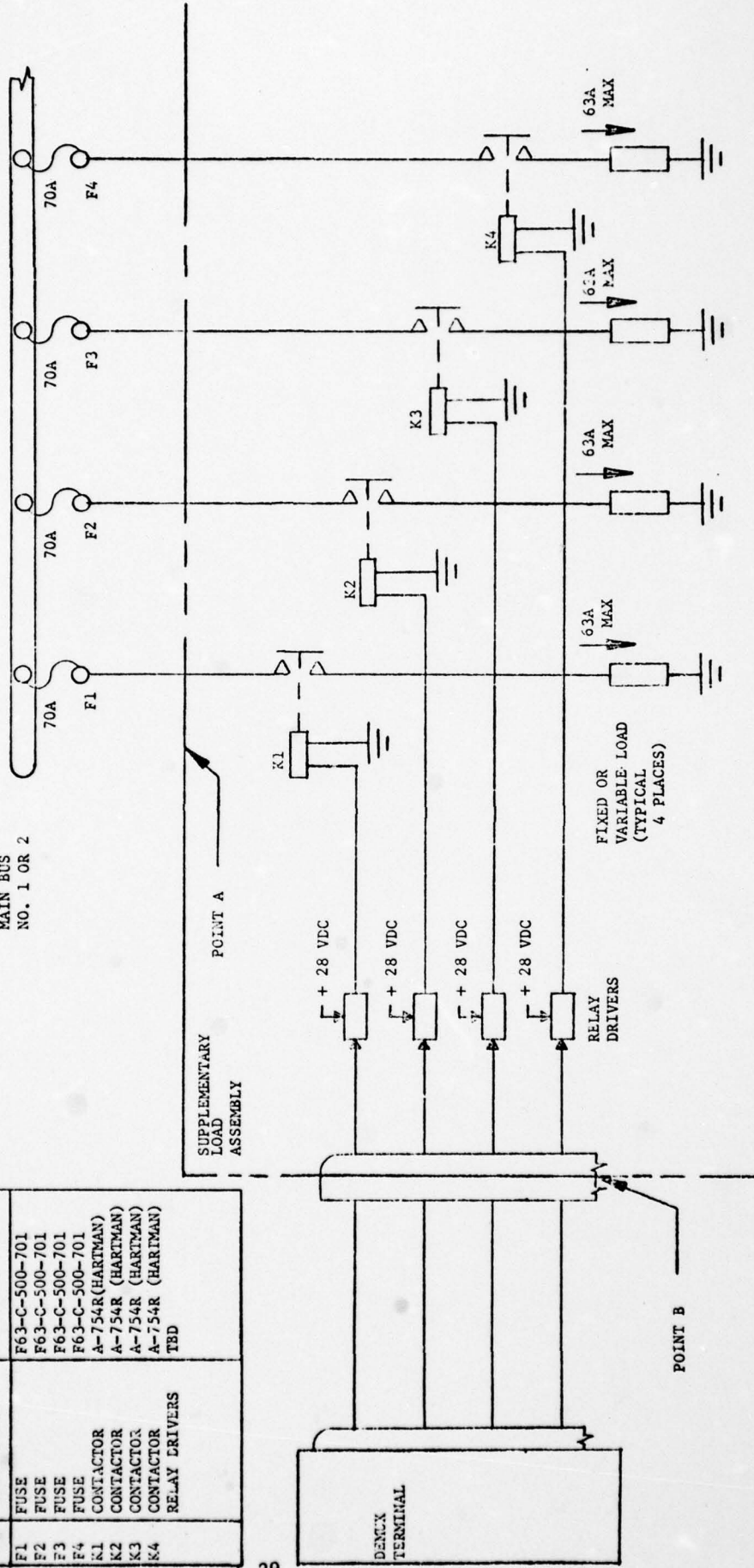


FIGURE 12 - HVDC SUPPLEMENTARY LOADING

HARDWARE LIST

REF DES	DESCRIPTION	PART NO.
CB1	CIRCUIT BREAKER	MS24571-50
CB2	CIRCUIT BREAKER	MS24571-50
CB3	CIRCUIT BREAKER	MS24571-50
CB4	CIRCUIT BREAKER	MS24571-50
K1	CONTACTOR	M6106/15-001
K2	CONTACTOR	M6106/15-001
K3	CONTACTOR	M6106/15-001
K4	CONTACTOR	M6106/15-001
	RELAY DRIVERS	TBD

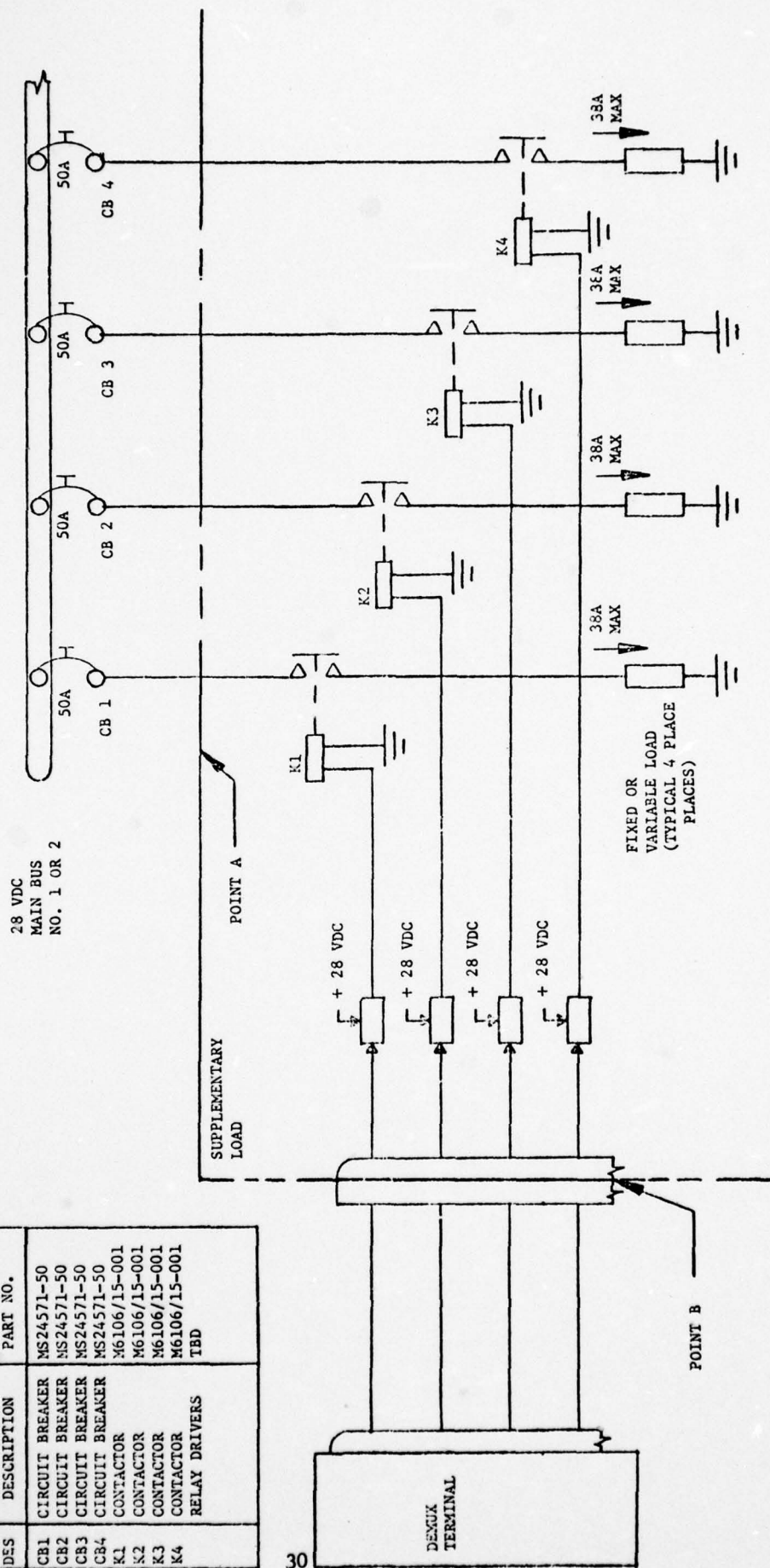


FIGURE 13 - 28 VDC SUPPLEMENTARY LOADING

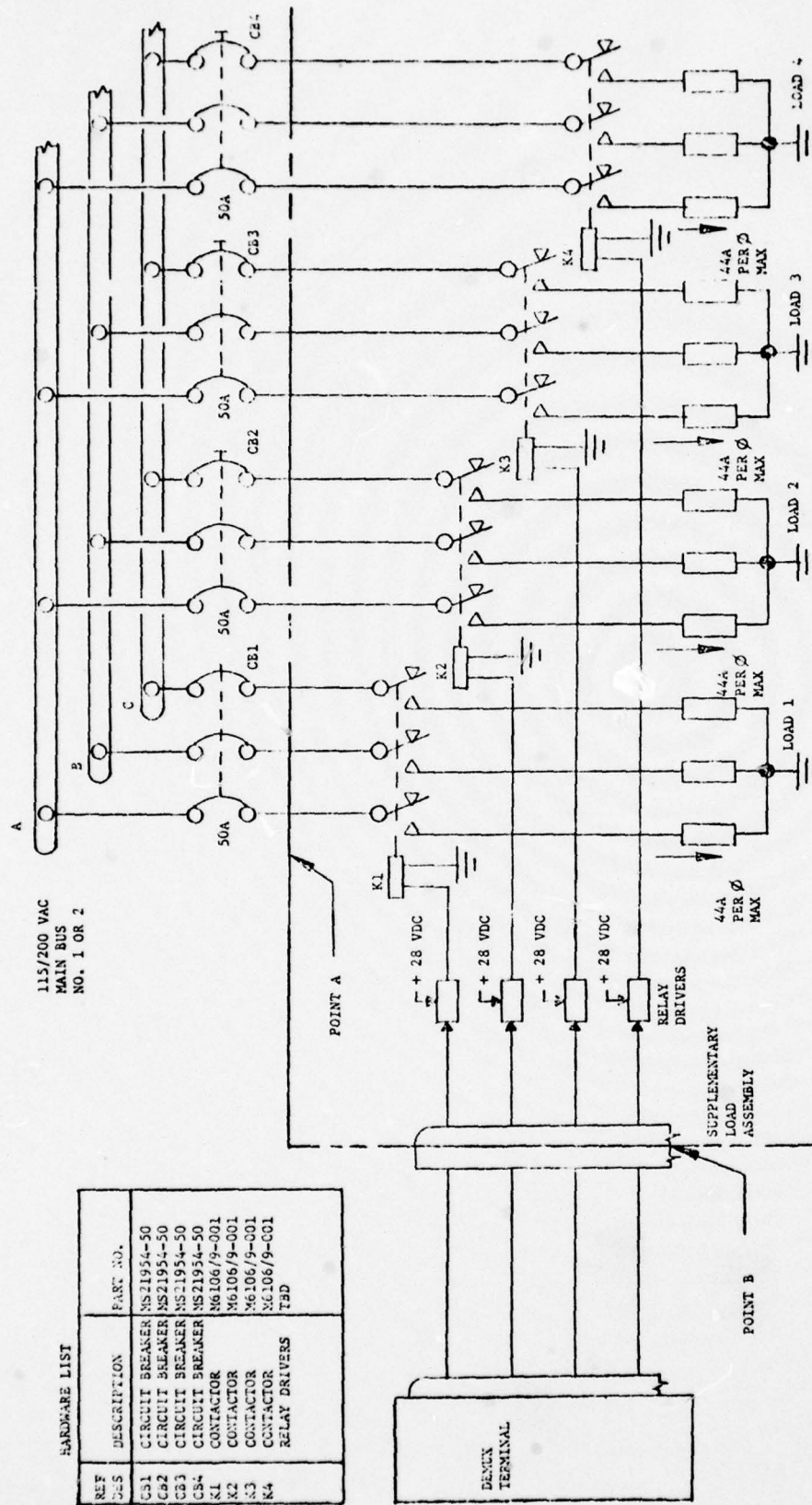


FIGURE 14 - 115/200 VAC SUPPLEMENTARY LOADING

REF	DESCRIPTION	PART NO.
CB1	CIRCUIT BREAKER	NS21954-50
CB2	CIRCUIT BREAKER	NS21954-50
CB3	CIRCUIT BREAKER	NS21954-50
CB4	CIRCUIT BREAKER	NS21954-50
K1	CONTACTOR	N6106/9-001
K2	CONTACTOR	N6106/9-001
K3	CONTACTOR	N6106/9-001
K4	CONTACTOR	N6106/9-001
	RELAY DRIVERS	TED

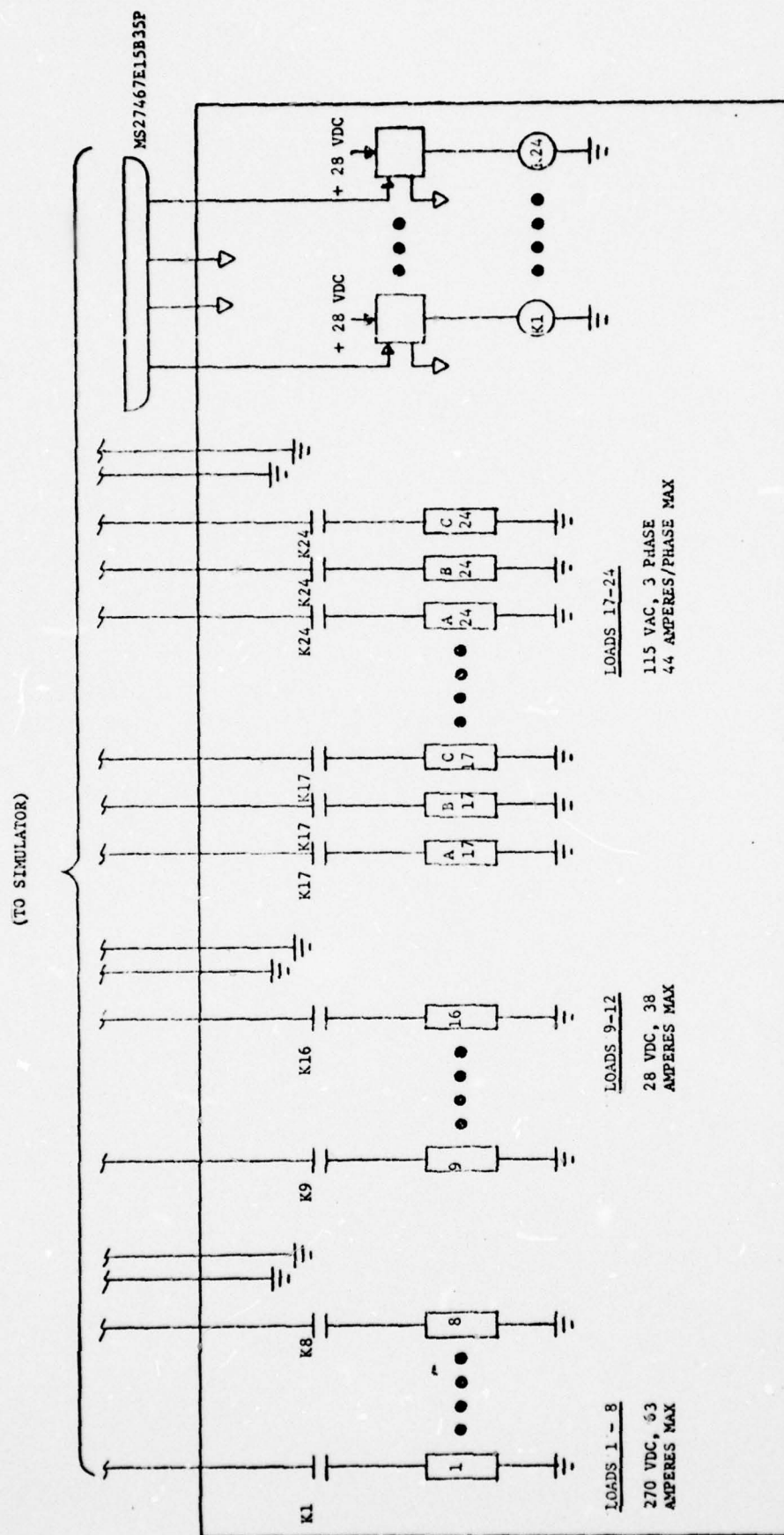


FIGURE 15 - SUPPLEMENTARY LOAD ASSEMBLY

The termination location reduces personnel hazards by eliminating exposed "hot" points on the simulator. The SCG demultiplex terminal channel interface is provided by a connector break at the simulator aft equipment shelves (Point B of Figures 12 through 14). A jumper plug will be provided with the simulator to maintain proper terminal channel loading (for SCG BIT) on these channels when the external dummy loading racks are not connected.

2.3.2.2 Hardware Requirements and Considerations

Hardware requirements and considerations for implementing and demonstrating the PGS supplementary loading involve the HVDC power contactors rated at 100 amperes, relay drivers for contactor control, and load banks having the required wattage ratings. These are discussed in the subsequent paragraphs.

1. HVDC Power Contactors

Due to the apparent lack of hybrid or solid state HVDC bus controller availability, large electromechanical contactors will likely be required for switching power to HVDC dummy loads. An "off-the-shelf" contactor has been identified for use as the main HVDC bus controller. This contactor, rated at 400 amperes at 270 VDC, requires considerable mounting space (at least 144 cubic inches per contactor) for the eight HVDC dummy load contactors required for the simulator implementation. A preferred approach is to use a contactor rated closer to the 75 ampere requirement. The manufacturer (Hartman) providing the 400 ampere contactor is presently investigating the adequacy and availability of an A-754-R series contactor for this application, i.e., a rating of 100 amperes at 270 VDC for the laboratory environment application. The coil voltage would remain at 28 VDC as currently used in the present A-754 contactor design.

2. Relay Driver

A device which provides the relay driver function is required. This device is certainly within the state-of-the-art, but requires design and fabrication. As previously stated, estimated driver load requirements are to switch 3.5 amperes at 28 VDC for 500 milliseconds and 0.4 amperes at 28 VDC continuous. The input control circuitry of the driver must be compatible with SCG terminal interface.

3. Load Bank

Figure 15 depicts the approximate load requirements needed for the supplementary loading of the PGS. Variable loads are desirable but not mandatory. Load power factors should be comparable to those used for testing the ADM generator and converter/inverter equipment. Use of existing NADC load banks is recommended to the extent of their availability and adequacy.

2.3.3 Simulator Grounding Requirements

Grounding philosophy to be employed on the AAES Simulator should include provisions for personnel safety and proper operation of equipment. To provide optimum safety to personnel, the simulator structure should be connected to earth ground or to some conducting body which serves in place of the earth. It is expected commercial Power (110/220 VAC, 60 Hz) operated equipment such as drills, lamps, power supplies, etc., will be used in the vicinity and on the simulator. A faulty equipment could result in the simulator being at commercial power potential if the simulator is not connected to earth.

All equipment enclosures should be electrically connected to the simulator structure. This is to preclude the housing being at some high potential due to an internal power-to-case fault. All equipment circuit grounds should be connected to the simulator structure. Equipment circuit grounds having isolated (different) power supplies should use separate ground terminals. For example, the 28 VDC ground and 115/200 VAC ground should not share the same ground terminal. Single point grounds should be used in applications where equipment operation is sensitive to EMI. Grounds isolated from the structure is permissible (from a personnel safety view point) in systems operating at not more than 30 volts (AC or DC) between conductors.

The use of a "shock hazard detection system" needs to be investigated. A shock hazard monitor would automatically disconnect the power source from the simulator in the event that the simulator structure is above ground potential.

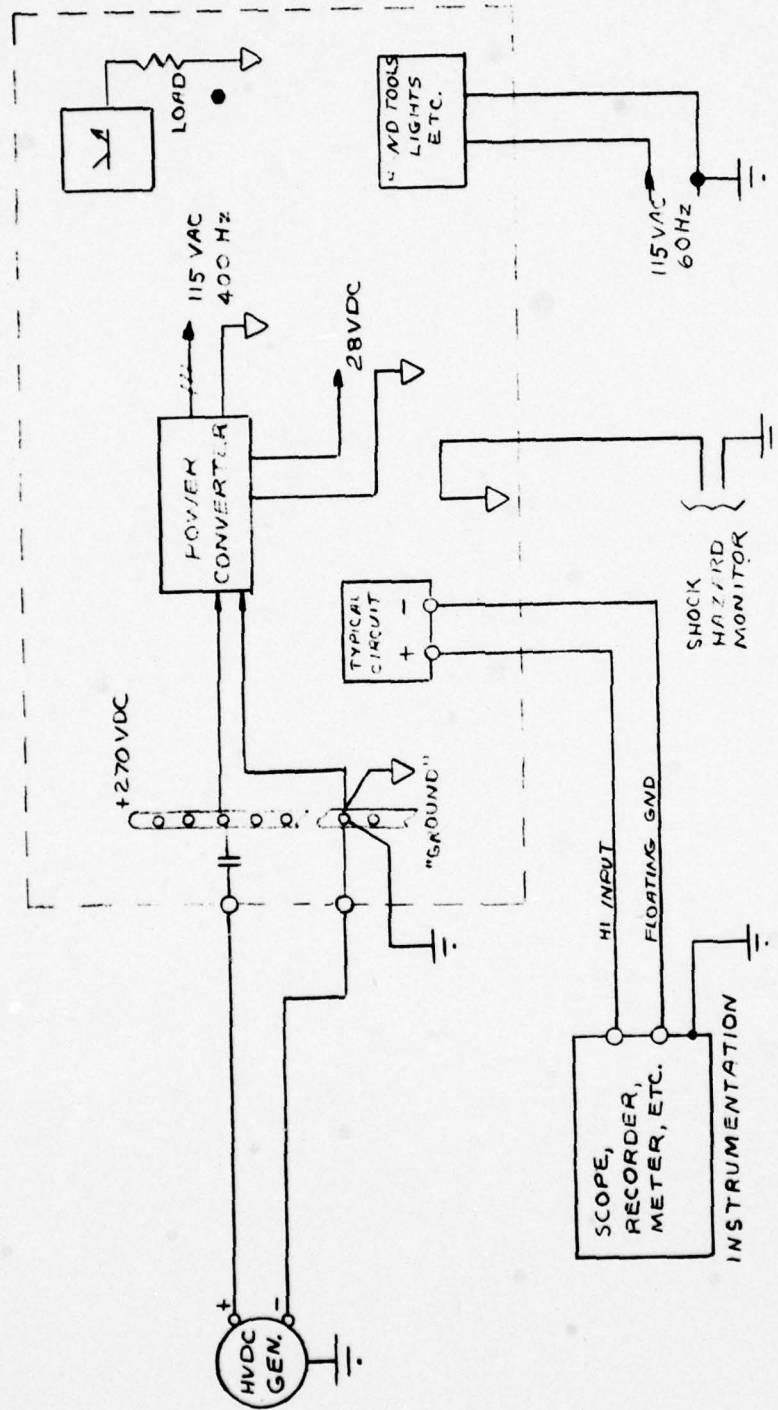
It is recommended that the PGS (270 VDC) power ground not be tied to the earth ground at the generator but at the earth ground point on the simulator. It is further recommended that the simulator structure not be used as the ground return for signal and HVDC power circuits. Instrumentation equipment should use a floating ground that is tied to the simulator common earth ground point with a sufficiently large conductor to minimize instrumentation error (based on instrumentation impedance circuit). The instrumentation equipment enclosure(s) should be tied to earth ground for safety. The grounding concept and requirements are schematically depicted in Figure 16.

2.3.4 A-7 Engine Pad Requirements

An assessment was made concerning the mounting drive requirements for the HVDC generator for application on the A-7. Interface and performance requirements were established for TA-7C (TF30-P-408 Engine) and the A-7E (TF41-A-2 Engine). These requirements are contained in Appendix A. Additionally, data was obtained on a gear box which has the potential for being used for interfacing the HVDC generator to the A-7 pad. The candidate gear box will provide the approximate required speed range; however, availability and torque requirements were not fully established. The gear box was used in conjunction with the 20 KVA VSCF Generator, General Electric Model No. 2CM38 and is illustrated in Figure 17. Availability and full compliance to AAES TA-7C system requirements should be established upon solidifying of the Flight Test Program Plans.

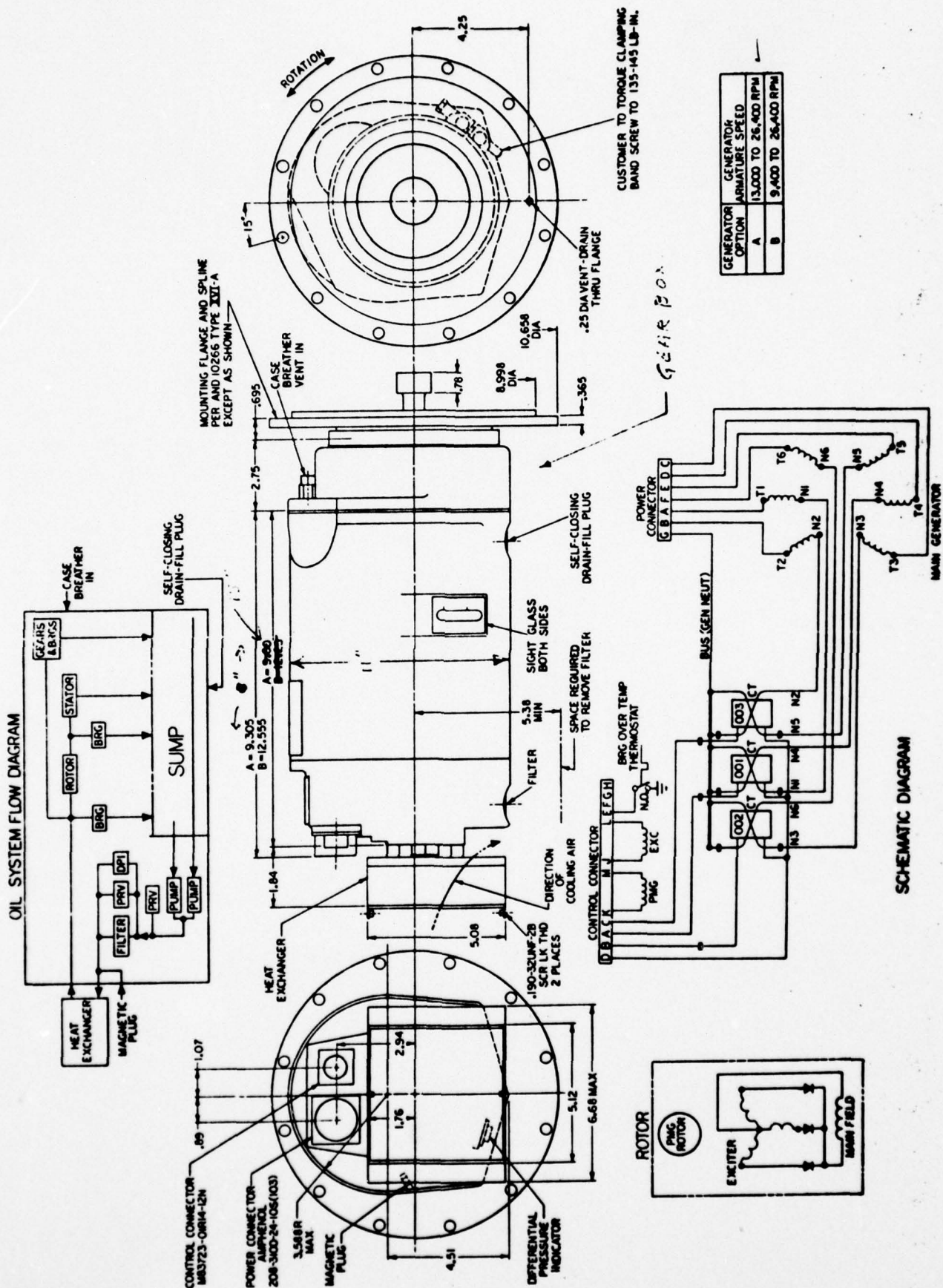
2.4 System Control and I/O Interface Requirements

The control logic in the form of Boolean combinational and sequential equations was prepared in conjunction with design of the AAES TA-7C subsystems and circuits. The formats and form in which these control equations were prepared are discussed in the subsequent paragraphs. Examples of methods for implementing and solving these equations using a one-bit processor and a more general purpose type processor are also provided. In addition, techniques were established for accomplishing the signal source function in the absence of a full complement of ADM solid state devices. Simulated signal sources, signal adapters and general purpose signal source panels, and airframe signal sources are defined for these purposes. Special purpose power output switches and lamp driver circuits are used for achieving the required interface between the demultiplexer and various aircraft "low power" loads. These devices and applications are described in the following paragraphs.



- ⏏ Earth Ground
 ⏏ Simulator Ground (Structure)
 • Structure Return vs Conductor Ground Return to be Established on Circuit by Circuit Basis.

FIGURE 16 - SIMULATOR GROUNDING REQUIREMENTS



GEZ-5206A-2

TABLE 3

[illegible]

2.4.1 System Control Equations

The control requirements were developed for each of the TA-7C subsystems designed for the AAES Simulator. This design information was prepared on keypunch coding forms. Table 3 contains typical Boolean equations which are used for control of the AAES TA-7C Simulator subsystems and circuits. Shown in the table are the form of the equations as currently written and the format to which they will be modified on the Full Simulator Development Contract. The change in format is required for achieving compatibility with the SCG hardware currently under development by the Garrett Corporation. Upon being updated to the required format and checked for completeness/correctness, the equations will be key-punched for listing. Both the listings and punched cards will be delivered on the Full Simulator Development contract. The basic control equations will also be shown on the wiring diagram drawings which are described in paragraph 2.2.

In addition to the basic system control equations SCG modifier equations were prepared for providing the load management control capability. These are also written on key-punch coding forms. These, like the basic Boolean control equations, will be revised to the Powertran format required by the SCG ADM hardware and key-punched. Listings will be prepared and the punched cards delivered under the Full Simulator Development contract.

Since four different (nonsimultaneous) checkout groups will be used to verify operation of all simulator subsystems, four separate sets of software are used for the SCG processor. In addition, one processor software set is used for the full-up simulator configuration. In that the basic Boolean equation for any specific load does not change between checkout groups (or full-up configuration), the difference between the five software sets is:

- a) the correlation between SCG terminal channels and input/output variable names, and
- b) activation or use of the applicable Boolean equations of the full complement.

The software "interface" data to be delivered with the simulator basically consists of the Boolean equations, equation modifiers, terminal bus address assignments and terminal channel assignments. This data will allow compilation of the operational software for the SCG processors using the POWERTRAN programming language. The control data to be delivered with the simulator will also define:

- a) the applicable checkout groups for each Boolean equation and equation modifier,
- b) the variable name assigned to each terminal channel for each of the four checkout groups; and
- c) the terminal bus address assignment for each checkout group.

It is noted that definition of terminal bus addresses and channel assignments for the full-up configuration cannot be completed until the final configuration and procured quantities of the SCG hardware are defined. Specifically, the SCG configuration variations yet to be fully established are the universal terminal concept versus the present dedicated multiplex or demultiplex terminal concept and subsequently the mix of dedicated multiplex, demultiplex, and multiplex/demultiplex terminals versus universal terminals.

As a means for more specifically establishing the computational capability and memory requirements needed by the SCG Processor for solving combinational/sequential logic control equations an analysis was conducted. The Z80 instruction set and the ICU one bit processor instruction set were compared for two different approaches for solving a typical sequential logic problem. These two approaches are: (1) a flow chart implementation and (2) a Boolean next state equation implementation.. The flow chart method proved to be the most efficient approach for solving the sequential logic problem for both processor instruction set implementations as is illustrated in Table 4.

TABLE 4

SUMMARY OF MEMORY REQUIREMENTS AND EXECUTION
TIMES FOR SEQUENTIAL EQUATION SOLUTION

	FLOW CHART METHOD		BOOLEAN EQUATION METHOD	
	MEMORY (BITS)	EXECUTION TIME μ S	MEMORY (BITS)	EXECUTION TIME μ S
Z80	496	34-70	1280	112-150
ICU	360	20	450	25

The memory requirements are given in terms of total bits since the word length is not the same for the Z80 and ICU. The Z80 memory is organized as an 8 bit byte, however, the ICU would be organized as an 18 bit word.

The ICU one bit processor proved to be much more efficient in terms of memory required and execution time; 20 microseconds execution time compared to 34 to 70 microseconds for the Z80, and 360 bits compared to 496 bits for the Z80 memory. There was even greater improvement in the ICU over the Z80 for the Boolean equation approach; 25 microseconds compared to 112 to 150 microseconds for the Z80, and 450 bits compared to 1280 bits of memory for the Z80.

It is noted that the Boolean equation approach requires six temporary scratch pad locations for implementation of software flip-flops and partial results. Only one temporary memory location was used in the flow diagram approach.

If a microprocessor is used for equation solutions, it is recommended that a one bit processor be used or an optimized Boolean solution instruction set be micro coded in a general processor for solving Boolean equations whether combinational or sequential.

In solving sequential Boolean equations, the flow chart approach proved to be more efficient than the Boolean logic method (20 words and 20 microseconds versus 25 words and 25 microseconds, respectively). This approach although more efficient, differs from the current equation solution approach where the computer compiler program takes the control equations and automatically generates the equation solution instructions. If the flow diagram approach is used, the flow diagram must be made for each sequential function and the program coded based on the flow diagram. A new compiler program could be written to do the compiling of the sequential equation functions based on the flow diagram algorithms, however, because of the limited number of sequential equations, the cost of this compiler would be difficult to justify. Standard combinational logic equations are generally solved as simply using the Boolean equation flow approach as compared to the flow chart method. ~

Sequential equations are basically ones that depend on memory elements. The memory elements can be provided by the scratch pad memory. Since the SCG specification requires a capability for 20 percent of the equations to be sequential with or without time delays, and one memory element per equation is assumed, then the processor requires about 200 locations in the scratch pad memory for the sequential circuits. When the requirement for time delays, partial solution to combinational logic, etc., are added, the processor scratch pad memory requirement is about 500 bits.

2.4.1.1 Sequential Circuit Implementation Example

The Automatic Carrier Landing System (ACLS) in the two-place TA-7C is controlled by either the Forward or Aft control panels. A push button switch is provided in both cockpits for alternately selecting either the Forward or Aft control panel for control of the Automatic Carrier Landing System. Each push button switch may be used to select or de-select control of the ACLS. Control is always given to either the Forward or Aft control panels. The push button switch is used to toggle this control from forward to aft or vice versa. Transfer of control is not allowed until the command - transfer pushbutton switch is released after having been activated.

The input and output variables for the sequential logic problem are defined below.

FWSFAC - Forward ACLS Command Transfer Switch
FWSAAC - Aft ACLS Command Transfer Switch
YACSEL - ACLS Control - Cockpit Select Transfer Command

The flow chart for the sequential circuit is shown in Table 5. Note that dummy variables FLG1 and FLG2 are used for implementing the sequential function. FLG1 is used to remember that FWSFAC has been activated. The transfer of control is initiated only after FWSFAC is deactivated provided that FLG1 was previously set by having activated FWSFAC. FLG2 serves the same purpose as FLG1 for the FWSAAC AFT ACLS command transfer switch.

Programming of this flow diagram for the Z80 microcomputer is shown in Table 5a, and for the 1-bit ICU processor in Table 5b.

The programming with the Z80 instruction set makes use of the bit set, reset and bit test instructions for an eight bit byte while the ICU

instruction set addresses each bit directly. Note that the ICU has a unique output enable (OEN) instruction which disables output store commands if the output enable variable is false. This enables the ICU to efficiently implement flow diagrams without branch on condition instructions.

The Boolean equation approach for the sequential circuit design is shown in Table 6. The equations, when implemented with software, perform the same sequential logic function as the flow diagram described previously.

Dummy variables FLG1, FLG2, S1, S2, and R1, R2 are used to control the sequential operation. The FLG1 and FLG2 equations are RS flip-flops which remember that the command transfer switches (FWSFAC and FWSAAC) have been activated. Equations S1 and S2 are partial solutions used in the toggle flip-flop equation YACSEL. Variables R1 and R2 are used to reset the FLG1 and FLG2 RS flip-flops after the command transfer switches have been released and control transfer has been completed.

TABLE 5
FLOW CHART SOLUTION
FOR SEQUENTIAL CIRCUIT

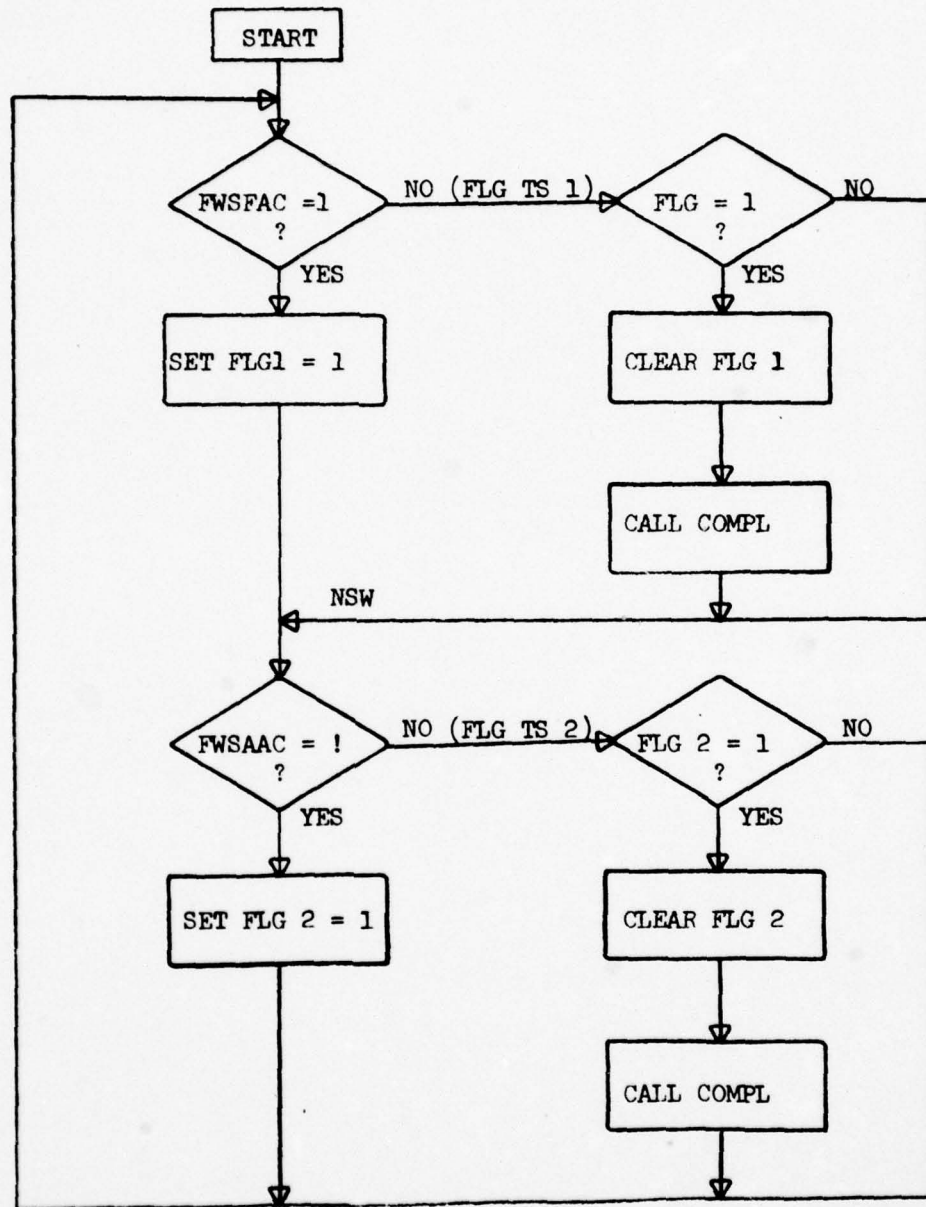
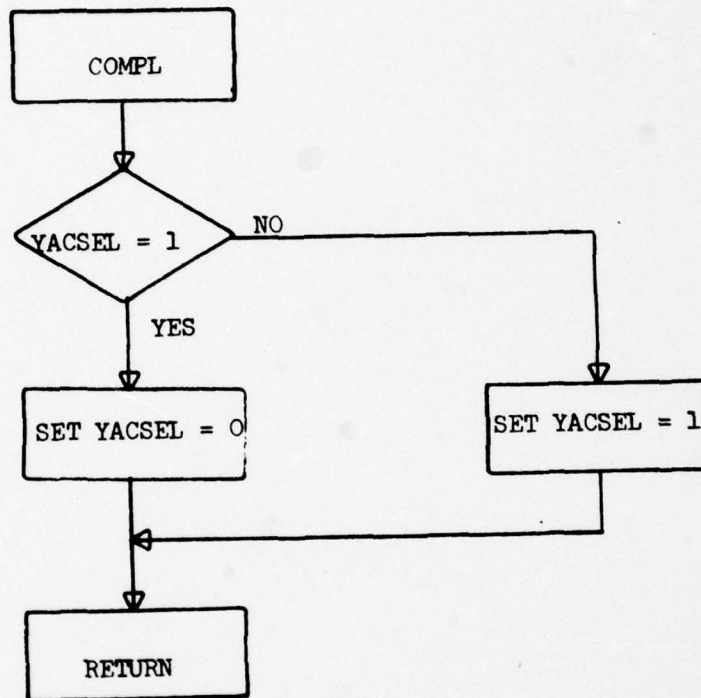


TABLE 5
(Continued)
FLOW CHART SOLUTION
FOR SEQUENTIAL CIRCUIT



BYTE ADDR.		<div> <div>BIT ADDR</div> <div> <div>7</div> <div>0</div> </div> <div>BYTE</div> </div>		T BYTES/STATES
START	LD A, (STATUS)	;	Get status byte	3/13
	LD HL, DABYTI	;	Get SW1 Byte Address	3/16
	BIT FWSFAC, (HL)	;	Is FWSFAC on?	2/12
	JR Z, FLGTS1	;	Jump if no	2/7
	SET FLG1, A	;	Set FLG1 in status byte	2/8
	JR NSW	;	Jump to next switch	2/12
FLGTS1	BIT FLG1, A	;	FLG1 Bit Set?	2/8
	JR Z, NSW	;	Jump if no	2/7
Instructions	RES, FLG1, A	;	Clear FLG1	2/8
ential Circuit)	CALL COMPL	;	Complement control bit	3/17
NSW	LD HL, DABYTZ	;	Get SW2 byte address	3/16
	BIT FWSAAC, (HL)	;	Is FWSAAC on?	2/12
	JR Z, FLGTS2	;	Jump if no	2/7
	SET FLG2, A	;	Set FLG2 in status word	2/8
SAVE:	LD (STATUS), A	;	Save status word	3/13
	JR START	;	Repeat	2/12
FLGTS2	BIT FLG2, A	;	FLG2 bit set?	2/8
	JR Z, SAVE	;	Jump if no	2/7
	RES FLG2, A	;	Clear FLG2	2/8
	CALL COMPL	;	Complement Bit control	3/17
	JR SAVE	;	Return	2/12
COMPL	LD HL, OUTBYT 1	;	Get contl bit byte address	3/16
	BIT YACSEL, (HL)	;	Is bit set?	2/12
	JR Z SET	;	Jump if no	2/7
	RES YACSEL, (HL)	;	Clear contl bit	2/8
	RET			1/10
SET	SET YACSEL, (HL)	;	Set contl bit	2/15
	RET			1/10
STATUS	DEFB 1	;	Flag byte location	1/0
DABYT1	EQU ADDSW1	;	Address of byte containing SW1	
FWSFAC	EQU BITSW1	;	Bit containing FWSFAC	
FLG1	EQU 0	;	Bit 0 equal FLG1	
FLG2	EQU 1	;	Bit 1 equal FLG2	
DABYT2	EQU ADDSW2	;	Address of byte containing SW2	
FWSAAC	EQU BITSW2	;	Bit containing FWSAAC	
OUTBYT1	EQU ADDCTL	;	Address of byte containing YACSEL	
YACSEL	EQU BITCTL	;	Bit containing YACSEL Function	

TABLE 5a
(Continued)

FLOW CHART SOLUTION USING
Z80 INSTRUCTION SET

Assumptions made for this program:

1. Input variables FWSFAC and FWSAAC are bits located in ITRAM, but not in same byte.
2. Output function YACSEL is a bit in the ORAM.
3. FLG1 and FLG2 bits are located in the same status byte in temporary RAM.
4. T State = 1 clock cycle = 0.25 μ sec

TOTAL MEMORY = 62 BYTES

Longest exec time = $(281 \times 0.25) = 70.25 \mu s$

Shortest exec time = $(136 \times 0.25) = 34 \mu s$

TABLE 5b
FLOW CHART SOLUTION USING
ICU ONE BIT PROCESSOR INSTRUCTION SET

START	LD FWSFAC	; Load FWSFAC
	STOC TEMP	; Save FWSFAC
	OEN RR	; Enable output 1F RR = 1
	STO FLG1	
	LD TEMP	; Load FWSFAC
	AND FLG1	; And FLG1
	OEN RR	; Enable output if RR = 1
	STOC FLG1	
	LD YACSEL	; Load YACSEL
	STOC YACSEL	; Complement YACSEL
	LD FWSAAC	; Load FWSAAC
	STOC TEMP	; Save FWSAAC
	OEN RR	; Enable output if RR = 1
	STO FLG2	
	LD TEMP	; Load FWSAAC
	AND FLG2	; And FLG2
	OEN RR	; Enable output if RR = 1
	STOC FLAG2	
	LD YACSEL	; Load YACSEL
	STOC YACSEL	; Complement YACSEL
	JMP START	

Total Memory = 20 Words

Execution Time = 20 μ s

18 bit words for
16K bit address field and
4 bit OPT code

TABLE 6

BOOLEAN EQUATION SOLUTION FOR SEQUENTIAL CIRCUIT

$$FLG1 = FWSFAC + \overline{R1} * FLG1$$

$$FLG2 = FWSAAC + \overline{R2} * FLG2$$

$$S1 = FLG1 * \overline{FWSFAC}$$

$$S2 = FLG2 * \overline{FWSAAC}$$

$$YACSEL = (S1 + S2) * \overline{YACSEL} + \overline{(S1 + S2)} * YACSEL$$

$$R1 = \overline{FWSFAC}$$

$$R2 = \overline{FWSAAC}$$

TABLE 6a
BOOLEAN EQUATION SOLUTION USING
Z80 INSTRUCTION SET

				T BYTES/STATES
(a) FLG1 (14 instructions)	EXEC TIME = 20.25 - 27.7 μ s	START	LD A, (STATUS)	; Get status 3/13
			LD HL, DATBYT1	; Get byte addr. 3/16
			BIT FWSFAC, (HL)	; Is FWSFAC on? 2/12
			JR Z, NXT1	; Jump if no 2/7
		SET1	SET FLG1, A	; Set FLG1 2/8
		OUT1	LD (STATUS), A	; Save status 3/13
			JR FLG2EQ	; Solve next equation 2/12
		NXT1	BIT R1, A	; Is R1 set? 2/8
			JR NZ, ZR01	; Jump if yes 2/7
			BIT FLG1, A	; Is FLG1 set? 2/8
			JR Z, ZR01	; Jump if no 2/7
			JR SET1	; Set FLG1 2/12
		ZR01	RES FLG1, A	; Clear FLG1 2/8
			JR OUT1	; Save status and return 2/12
FLG2 (13 instructions)	EXEC TIME = 17 - 28.75 μ s	FLG2EQ	LD HL, DATBYT2	; Get byte addr. 3/16
			BIT FWSAAC, (HL)	; Is FWSAAC set? 2/12
			JR. Z, NXT2	; Jump if no 2/7
		SET2	SET FLG2, A	; Set FLG2 2/8
		OUT2	LD (STATUS), A	; Save status 3/13
			JR S2EQ	; Solve next equation 2/12
		NXT2	BIT R2, A	; Test R2 2/8
			JR NZ, ZR02	; Jump if not zero 2/12
			BIT FIG2, A	; Test FLG2 2/8
			JR Z, ZR02	; Jump if zero 2/7
			JR SET 2,	; Set FLG2 2/12
		ZR02	RES FLG2, A	; Clear FLG2 2/8
			JR OUT2	; Save and return 2/12
S2 (9 instructions)	EXEC TIME = 15 - 16.75 μ s	S2EQ	BIT FLG2, A	; Test FLG2 2/8
			JR Z, ZR03	; Jump if zero 2/7
			BIT FWSAAC, (HL)	; Test FWSAAC 2/12
			JR NZ, ZR03	; Jump if not zero 2/7
			SET S2, A	; Set S2 2/8
		OUT3	LD (STATUS), A	; Save status and 3/13
			JR S1EQ	; Next Equation 2/12
		ZR03	RES S2, A	; Zero answer 2/8
			JR OUT3	; 2/12
		S1EQ	BIT FLG1, A	; Test FLG1 2/8
			JR Z, ZR04	; Jump if zero 2/7
			LD HL, DATBYT1	; Get Byte address 3/16
			BIT FWSFAC, (HL)	; Is FWSFAC on? 2/12
S1 (10 instructions)	EXEC TIME = 15 - 23.75 μ s		JR NZ, ZR04	; Jump if on 2/7
			SET S1, A	; One answer 2/8
		OUT4	LD (STATUS), A	; Save status 3/13
			JR YACEQ	; Next equation 2/12
		ZR04	RES S1, A	; Zero answer 2/9
			JR OUT4	; 2/12

TABLE 6a
(Continued)

BOOLEAN EQUATION SOLUTION USING
Z80 INSTRUCTION SET

				T BYTES/STATES	
YACSEL (14 instructions)	EXEC TIME = 21.25 - 27.5 μs	YACEQ	LD HL, OUTBYT1 ; Get byte address	3/16	
			BIT YACSEL, (HL) ; Is YACSEL set?	2/12	
			JR Z, NXT3 ; Jump if no	2/7	
			BIT S1, A ; Test S1	2/8	
			JR NZ, NXT3 ; Jump if not zero	2/7	
			BIT S2, A ; Is S2 set?	2/8	
			JR NZ, NXT3 ; Jump if yes	2/7	
		OUT5	SET YACSEL, (HL) ; Set ORAM Bit	2/8	
			JR EQR1 ; Next equation	2/12	
		NXT3	BIT S1, A ; Is S1 set?	2/8	
			JR NZ, OUT5 ; Jump if yes	2/7	
			BIT S2, A ; Is S2 set?	2/8	
			JR NZ, OUT5 ; Jump if yes	2/7	
			RES YACSEL, (HL) ; Clear ORAM Bit	2/15	
R1 (6 instructions)	EXEC TIME = 12.75 μs 9.75 μs	EQR1	LD HL, DATBYT1 ; Get byte address	3/16	
			BIT FWSFAC, (HL) ; Test FWSFAC	2/8	
			JR NZ, ZR05 ; Jump if not zero	2/7	
			SET R1, A ; Set R1	2/8	
			JR EQ R2 ; Next equation	2/12	
		ZR05	RES R1, A ; Clear R1	2/8	
		EQR2	LD HL, DATBYT2 ; Get byte address	3/16	
			BIT FWSAAC, (HL) ; Test FWSAAC	2/12	
			JR NZ, ZR06 ; Jump if set	2/7	
			SET R2, A ; Set R2	2/8	
			JP START ; Repeat	3/10	
		ZR06	RES R2, A ; Clear R2	2/8	
			JP START ; Repeat	3/10	
STATUS		DEFB 0 ; Status location	1/0		
DATBYT1		EQU ADDSW1 ; Address of byte containing SW1			
FWSFAC		EQU BITSW1 ; Bit containing FWSFAC			
FLG1		EQU 1 ; Bit 1			
FLG2		EQU 2 ; Bit 2			
S1		EQU 3			
S2		EQU 4			
R1		EQU 5			
R2		EQU 6			
YACSEL		EQU BITCTL ; Bit in ORAM for contrl func.			
OUTBYT1		EQU ADDCTL ; Address of byte containing YACSEL			
DATBYT2		EQU ADDSW2			
TOTAL BYTES = 160 BYTES					
Longest Exec time = 150.45 μs					
Shortest Exec time = 111.5 μs					

TABLE 6b
 BOOLEAN EQUATION SOLUTION USING
 MOTOROLA ICU ONE-BIT PROCESSOR

FLG1	START	LDC R1	; Load Complement R1
4 instructions		AND FLG1	; and FLG1
ET = 4 μ s		OR FWSFAC	; Or FWSFAC
		STO FLG1	; Store in FLG1
FLG2		LDC R2	; Load complement R2
4 instructions		AND FLG2	; And with FLG2
ET = 4 μ s		OR FWSAAC	; Or with FWSAAC
		STO FLG2	; Store in FLG2
S1		LDC FWSFAC	: Load Complement FWSFAC
3 instructions		AND FLG1	; And with FLG1
ET = 3 μ s		STO S1	; Store in S1
S2		LDC FWSAAC	; Load complement FWSAAC
31 instructions		AND FLG2	; And with FLG2
ET = 3 μ s		STO S2	; Store in S2
YACSEL		LD S1	; Load S1
6 instructions		OR S2	; Or with S2
ET = 6 μ s		STO TEM	; Store in tem
		LD YACSEL	; Load YACSEL
		XNOR TEM	; Exclusive or with YACSEL
		STO YACSEL	; Store in YACSEL
R1		LDC FWSFAC	; Load complement FWSFAC
2 instructions		STO R1	; Store in R1
ET = 2 μ s			
R2		LDC FWSAAC	; Load complement FWSAAC
3 instructions		STO R1	; Store in R1
ET = 3 μ s		JMP START	; Repeat

TOTAL MEMORY = 25 WORDS

EXECUTION TIME = 25 μ s

2.4.2 Signal Source Implementation Methods

A wide variety of signal source types and installation designs are used in the TA-7C. As identified in Table 7, several design alternatives exist for the AAES signal source implementation. These include replacement of the conventional switch function with a solid state signal source, adding resistors to the existing contact type switch to provide the signal source function, and using external signal conditioning. The advantages and disadvantages of each design approach are listed in Table 7. The use of solid state transducers are preferred. However, due to the limited quantities of signal sources and also because of retrofit difficulty in some equipments, either the simulated signal source or external conditioning approaches are used. Retrofit difficulty is typically a result of unique switch physical configuration or inaccessibility of the switch, i.e., in an actuator, avionic subsystem, etc. Figure 18 is representative of both of these cases. Table 8 provides a summary of the switch types needed for this representative application and the implementation alternatives.

Because of the limited types, quantities and initial inavailability of ADM signal sources being procured for the simulator, simulated signals sources and "existing switches" buffered with signal conditioning circuits will be used on the simulator. The evolved system designs described in paragraph 2.2 are based on using these methods to achieve a "full-up" implementation of signal sources in the simulator. A total of 152 signal sources consisting of 5 types are used in the simulator system.

2.4.2.1 General Purpose Signal Source Panels

The transducers associated with airframe actuated functions cannot feasibly be implemented on the simulator. Typical of these functions are landing gear and control surface position sensing transducers. The simulator design uses toggle and rotary signal sources mounted on three special purpose panels to provide the input signals to the SCG for these type functions. This allows representative system operation without the need for the large, complex and costly mechanization of the moving surfaces and pressurized fluid subsystems. However, the general purpose panels are minimally used since their application is restricted to functions which are not an integral part of the simulator.

2.4.2.2 Signal Conditioners

Signal conditioner cards were defined for achieving compatibility between the SCG and signals emanating from various avionic "black boxes". The subsystem and circuit designs were developed based on use of five signal conditioner assemblies. A total of 137 conditioner channels consisting of five types of conditioners are required for the "full-up" simulator. The system design and adapter harness assemblies are based on a full set of signal conditioners and simulated signal sources being supplied with the simulator. Thus, the only factor which requires use of the modular concept (in the input control area) is the reduced quantity of multiplex terminals needed for simultaneous operation of all simulator subsystems. Use of the signal conditioners in conjunction with the modular concept is depicted in Figure 19.

TABLE 7

COMPARISON OF CONVERSION APPROACHES

APPROACH	ADVANTAGE	DISADVANTAGE
REPLACE WITH SOLID STATE TRANSDUCER	<ul style="list-style-type: none"> ○ BIT UP TO (& INCLUDING) SIGNAL SOURCE ○ REPRESENTATIVE OF FUTURE IMPLEMENTATION ○ AIRFRAME WIRING LESS COMPLEX ○ OVERALL SYSTEM MORE RELIABLE 	<ul style="list-style-type: none"> ○ NON-STANDARD SIGNAL TRANSDUCERS ○ REWORK OF EQUIPMENT REQUIRED ○ HIGHEST INITIAL COST (RELATIVE COST = 50C) ○ REQUIRES EQUIPMENT TO BE AVAILABLE DURING SIMULATOR CONSTRUCTION
ADD RESISTOR NETWORK INTO EQUIPMENT	<ul style="list-style-type: none"> ○ BIT UP TO EQUIPMENT ○ AIRFRAME WIRING LESS COMPLEX ○ USE EXISTING EM SWITCHES ○ AIRFRAME PART OF SYSTEM REPRESENTATIVE OF FUTURE IMPLEMENTATION 	<ul style="list-style-type: none"> ○ REWORK OF EQUIPMENT REQUIRED ○ MEDIUM INITIAL COST (RELATIVE COST = 5C) ○ RELIABILITY IMPACT OF SWITCHING LOW LEVEL SIGNALS ○ REQUIRES EQUIPMENT TO BE AVAILABLE DURING SIMULATOR CONSTRUCTION
USE EXTERNAL SIGNAL CONDITIONING	<ul style="list-style-type: none"> ○ LOW COST (RELATIVE COST = 1C) ○ USE EXISTING EQUIPMENT WITHOUT MODIFICATION ○ DOES NOT REQUIRE EQUIPMENT TO BE AVAILABLE DURING SIMULATOR CONSTRUCTION 	<ul style="list-style-type: none"> ○ MORE COMPLEX AIRFRAME WIRING ○ LEAST RELIABLE ○ LIMITED BIT ○ NOT REPRESENTATIVE OF FUTURE IMPLEMENTATION

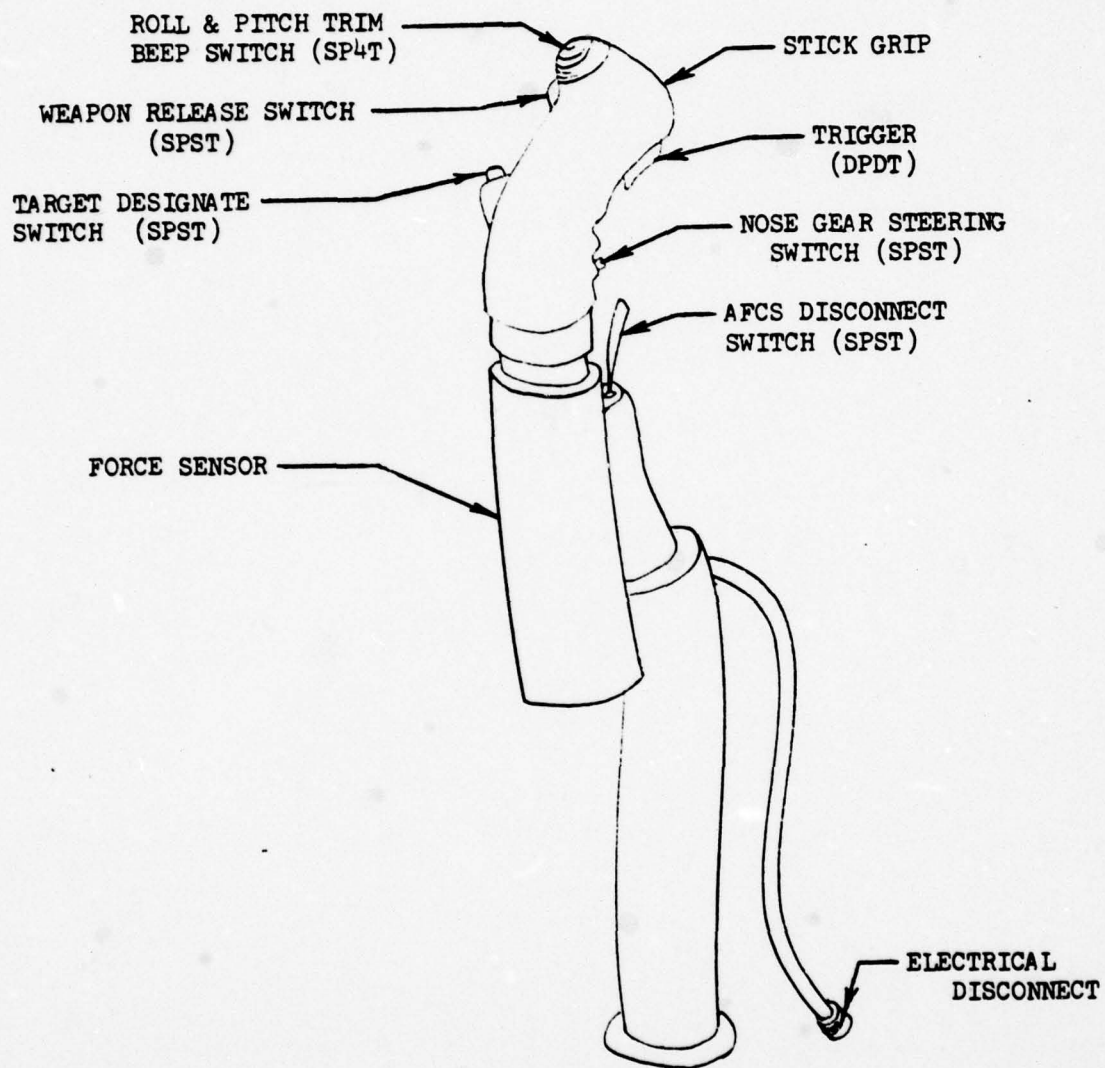
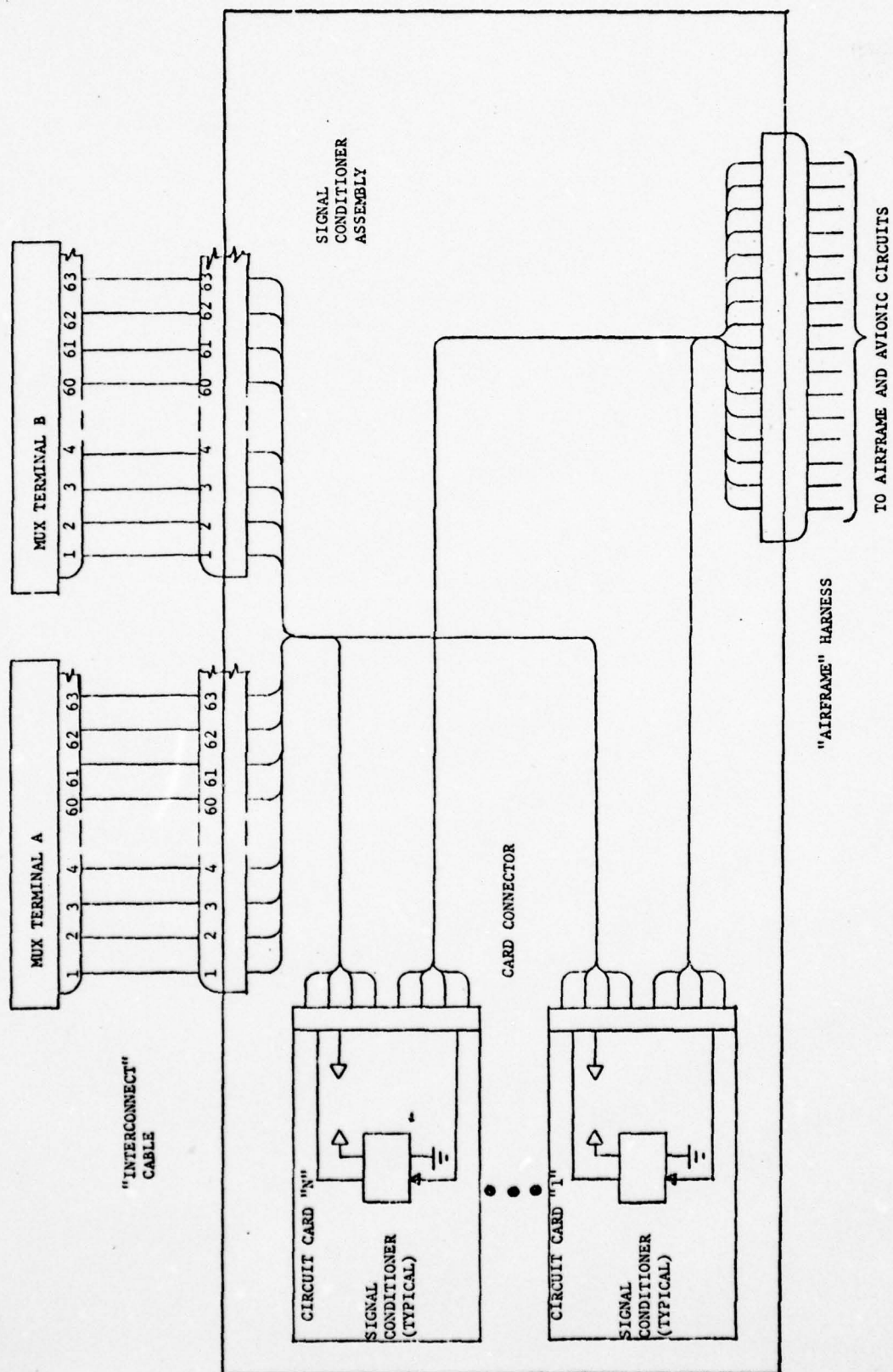


FIGURE 18
CONTROL STICK ASSEMBLY

TABLE 8
SIGNAL SOURCE CONVERSION EXAMPLE

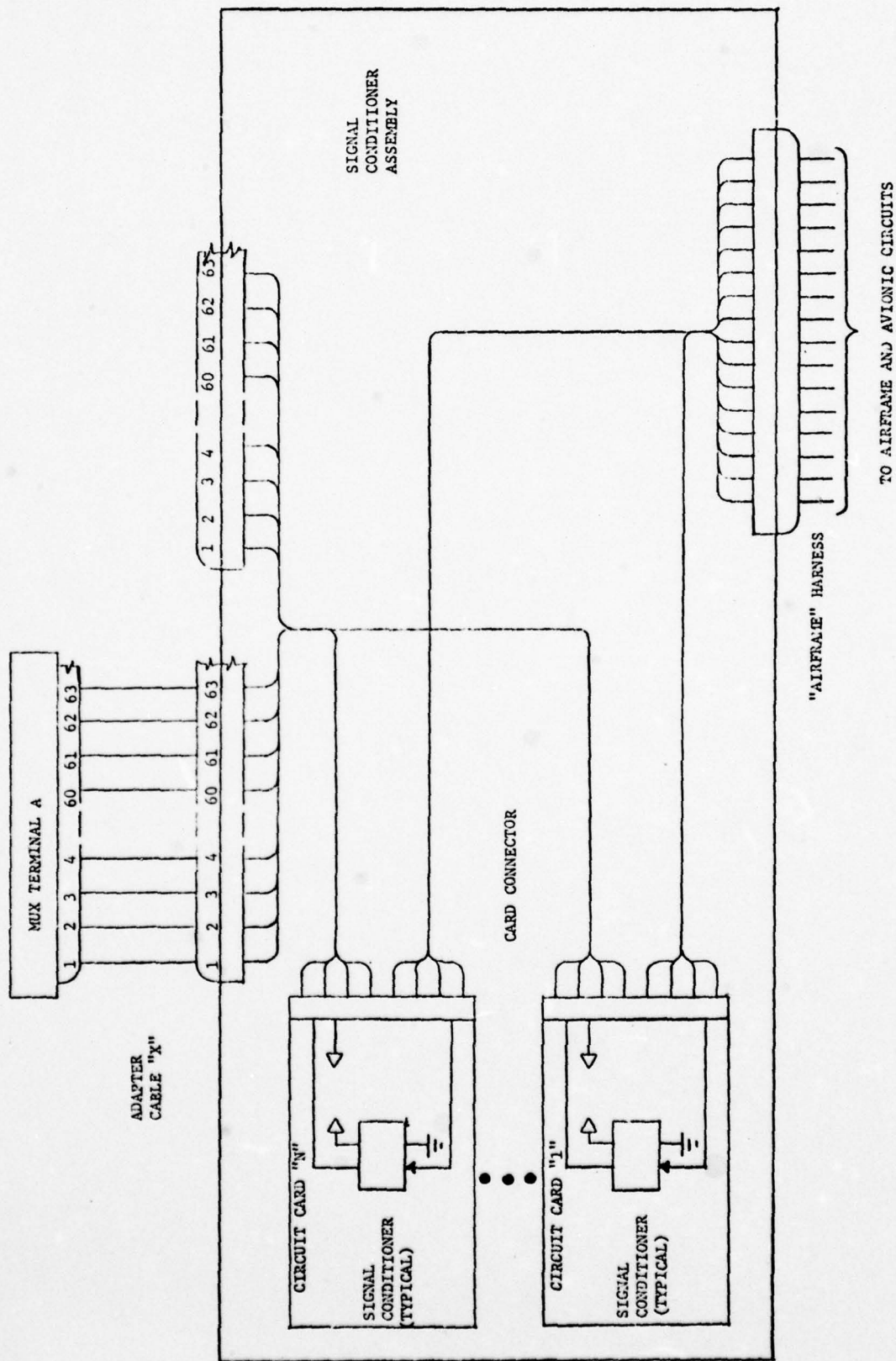
CONTROL STICK ASSEMBLY

- o SIGNAL SOURCES TO INTERFACE WITH AAES
 - ROLL & PITCH TRIM SWITCH (SP4T)
(MS27708-3)
 - WEAPON RELEASE SWITCH (SPST)
(MS25089-4AR)
 - TARGET DESIGNATE SWITCH (SPST)
(MS25089-5AR)
 - NOSE GEAR STEERING ENABLE SWITCH (SPST)
(MS25089-4AR)
 - TRIGGER SWITCH (DPDT)
(SPECIAL)
 - AFCS DISCONNECT SWITCH (SPST)
(SPECIAL)
- o TECHNIQUES OF ADAPTION TO AAES
 - REPLACE EM SWITCH WITH SOLID STATE TRANSDUCER
 - ADD RESISTOR DIVIDER NETWORK IN STICK GRIP ASSEMBLY
OR IN FORCE SENSOR
 - WIRE CONTROL STICK TO MUX TERMINAL VIA SIGNAL
CONDITIONER CARD



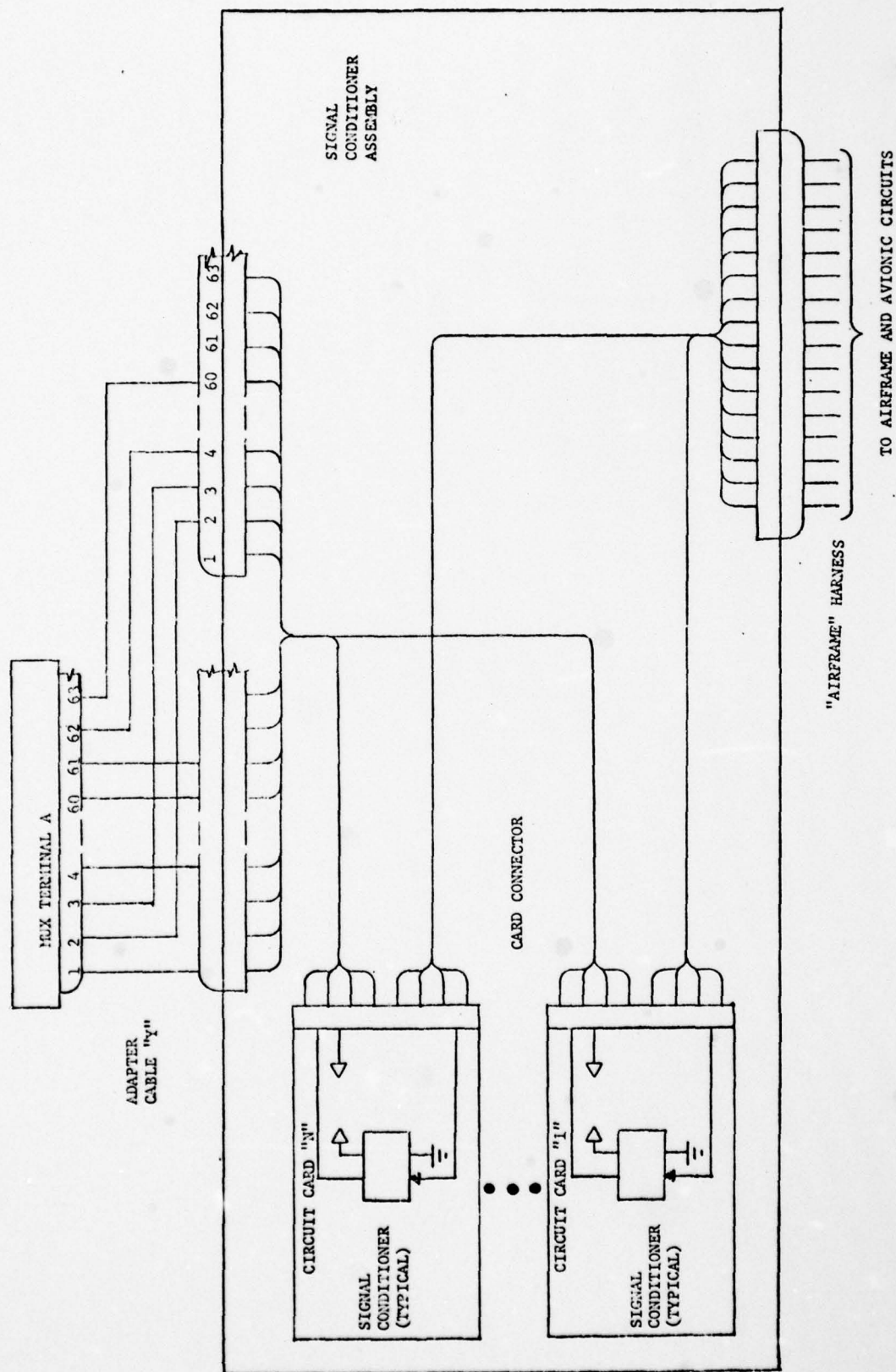
(a) FULL-UP SIMULATOR

FIGURE 19 - SIGNAL CONDITIONER IMPLEMENTATION



(b) CHECKOUT GROUP X

FIGURE 19 - SIGNAL CONDITIONER IMPLEMENTATION



(c) CHECKOUT GROUP Y

FIGURE 19 - SIGNAL CONDITIONER IMPLEMENTATION

Figure 19a depicts the signal conditioner interface with the multiplex terminals and airframe harnessing for a full-up simulator configuration. As shown in the figure, the airframe harness connects directly to the signal conditioner assembly. The multiplex terminals, however, connect to the signal conditioner assembly through an interconnect cable. The primary factors requiring use of the interconnect cable is that the multiplex terminals must interface both the signal conditioner assembly and airframe harnesses for access to signal transducers mounted in various assemblies. This airframe harness interface eliminates the ability to connect the signal conditioner assembly harness directly to the multiplex terminals.

For the simulator interim configuration, the multiplex terminal-to-signal conditioner interconnect cable will be replaced by a series of adapter cables which connect the limited multiplex terminal channels to selected signal conditioners. Figures 19-b and 19-c illustrate use of adapter harnesses for reassignment of the available multiplex terminal channels for two representative checkout groups. Thus, by using adapter cables between the multiplex terminals and signal conditioner assemblies, all AAES Simulator subsystems can be operated and evaluated with the limited number of SCG multiplex terminals. The full-up simulator configuration is achieved (in the input control area) by inserting the "full-up" interconnect harness.

2.4.3 Load Controllers

The load controllers cannot be feasibly simulated as could the signal sources. Therefore, the simulator system and wire harness designs are based on sharing the available quantities of load controllers. This design approach was discussed in paragraph 2.1 under the modular design concept. To achieve the full-up system (in the output power and control areas) requires that full quantities of controllers be installed in the LMCs and removal of the two adapter harness associated with each LMC. A total of 342 controllers are required for the full-up simulator, however, a total of only 200 controllers (28VDC, 270VDC, 26VAC, and 115VAC) are required with the modular concept.

2.4.3.1 Power Output Switches

Application of the modular concept to the low level power output switches is comparable to the implementation concept used for signal conditioners. In both cases sufficient low-level power output devices will be fabricated to service the full-up simulator configuration. The limitation forcing use of the modular implementation is the limited number of demultiplex terminals. However, since the power output card assemblies are installed within the LMCs, the modular implementation is the same as that used for load controllers in paragraph 2.1.

The circuit interconnection for the low level power output switches corresponds to that shown in Figure 2-b through 2-d except a full quantity of drivers are provided. The only hardware sharing required is for terminal channels. For this reason, conversion between checkout groups in the initial simulator configuration is accomplished by changing adapter cables between the LMC (low level power output devices) and the demultiplex terminals and between the LMC and "airframe" harness. Rework of the initial simulator to the full-up arrangement only

requires removing the adapter cables associated with the LMC and reconnecting the associated SCG terminal, LMC and airframe harness connectors.

A quantity of 122 output drivers consisting of five basic types are used in the simulator design.

2.4.3.2 Solid State Lamp Drivers

The simulator system design is based on using a full set of lamp driver assemblies. The interconnect technique for the lamp drivers is the same as that used for the signal conditioning modules described in paragraph 2.4.2.2, Figures 19-a through 19-b. Conversion between the four checkout groups and the full-up simulator is achieved through interchanging the adapter harnesses. A total of 265 lamp drivers consisting of 3 types are used in the simulator.

2.4.4 Simulator Equipment Utilization

In order to provide an overview of the equipment requirements for both the full-up and the interim modular implementations, summary tables were prepared, Tables 9 and 10. Table 9 lists the ADM hardware requirements. Shown are the quantities of hardware being procured for each device and rating. Also shown are the quantity of hardware for the full-up and modular arrangements. Since the modular arrangement contains four checkout groups, the quantity of hardware "active" during each group is shown. It is further noted that the full-up and interim quantity of SCG terminals is based on the ADM "types" of hardware. If Universal Terminals are used in transitioning to the full-up system, a total of 19 will be required. Also, in the area of signal sources, the simulator will be initially implemented with a full set of Vought furnished simulated signal sources. The table does not reflect requirements that may occur in order to fully accommodate integration of the AAS (Advanced Armament System) capability.

Table 10 identifies the quantity of supplementary hardware required for the simulator. The supplementary equipment consists of the signal conditioners (5 types as shown), power output switches (5 types as shown), lamp drivers (3 types as shown) and the adapter cables. Since Vought is to supply a full-up set of the supplementary equipment items, the full-up and modular implementation quantities are the same. Since in most of the simulator system areas, the full-up arrangement is derived by removing adapter cables and connecting up the basic system wire harness connectors, only 6 interconnect harnesses are required for the full-up implementation.

Appendix B contains the list of GFE required for the simulator. Table B-1 is the baseline GFE recommended for inclusion on the simulator. These GFE items will allow checkout and evaluation of the systems and circuits which can be operated in a meaningful manner. Table B-2 contains a list of additional GFE that is relevant to the TA-7C simulator. However, these equipments cannot be "fully operated" or would be difficult to "adequately evaluate" as a result of basic limitations of the simulator. As an example, M61 gun clearing solenoid can be operated but should be loaded and checked for force and actuation time to fully determine if degradation of performance occurs as a result of the AAES implementation.

TABLE 9
ADM HARDWARE UTILIZATION

Item	Qty Procured	Qty Used		System Checkout Group			
		Full-Up	Modular Checkout	1	2	3	4
<u>SCG Equipment</u>							
o Processors	2	2	2	2	2	2	2
o Maintenance Panel	1	1	1	1	1	1	1
o Pilot Control Panel	1	1	1	1	1	1	1
o Multiplexer	6	5	5	5	5	5	5
o Demultiplexer	6	11	5	5	5	5	5
o Mux/Demux	4	5	3	3	3	3	3
o Data Bus Couplers	AR	50	34	34	34	34	34
<u>Power Controllers</u>							
<u>28VDC Load Control</u>							
o 1/2 Amp	25	38	22	10	20	13	13
o 2 Amp	45	83	41	17	35	25	25
o 5 Amp	15	29	15	4	5	8	7
o 10 Amp	15	20	10	8	0	0	2
<u>115 VAC Load Control</u>							
o 1/2 Amp	25	29	21	8	10	16	5
o 2 Amp	45	66	38	19	31	29	19
o 5 Amp	15	31	15	3	4	9	7
<u>26 VAC Load Control</u>							
o 1 Amp	15	16	13	1	5	10	6
<u>270 VDC Load Control</u>							
o 2 Amp	40	30	30	30	30	30	30
<u>Signal Sources</u>							
o Toggle (SPST)	65	51	51	17	29	27	31
o Toggle (SPDT)	0	27	27	5	7	11	16
o Pushbutton Ltd	65	45	45	17	0	27	16
o Rotary	35	18	18	18	0	0	0
o Proximity	35	14	14	6	6	13	12

Alternate total quantity is 19 universal terminals.

TABLE 10
SUPPLEMENTARY HARDWARE UTILIZATION

Item	Qty Procured	Qty Used		System Checkout Group			
		Full-Up	Modular Checkout	1	2	3	4
<u>Signal Conditioners</u>							
o Type 1 - Ground or Open/28VDC	43	43	43	6	18	14	14
o Type 2 - Open/Ground	36	36	36	11	6	10	8
o Type 3 - Open/Con- tinuity	44	44	44	11	23	9	11
o Type 4 - Open/28VDC or Ground	12	12	12	12	0	0	0
5 Type 5 - Ground or Open/5VDC	2	2	2	2	0	2	0
<u>Power Output</u>							
o Type 1 - 28V, 400 ma	69	69	69	24	19	28	12
o Type 2 - Grd, 250 ma	43	43	43	23	9	9	19
o Type 3 - Grd, 2.5 a	3	3	3	1	0	1	1
o Type 4 - SPDT, 100 ma	2	2	2	0	0	2	0
o Type 5 - 6V, 100 ma	5	5	5	0	0	5	0
<u>Lamp Drivers</u>							
o Type 1 - 28V at 80 ma	120	120	120	32	40	45	34
o Type 2 - 6V at 400 ma	133	133	133	75	0	58	23
o Type 3 - 28V at 340 ma	6	6	6	0	6	2	0
Adapter Cables	AR	6	67	24	20	20	20

2.4.5 Load Management System

SOSTEL provides a capability for automatically adjusting power bus loading to match the generating system capacity. The load management capability greatly simplifies the bus management hardware requirements while providing a more sensitive bus loading control than can be feasibly implemented with conventional techniques. Reference 1 provides a discussion of the load management concept and identifies the benefits that it provides. The load management operation uses the inherent computerized control of SOSTEL for controlling the flow of power to individual loads. This allows loads to be powered-up or powered-down as a function of the power system capacity by providing the proper control equations in the SCG processors. Two sets of control data have been defined.

The first data set consists of the load management modifiers and are in accordance with the format of the Powertran Reference Manual². A load management modifier has been defined for essentially all of the SCG output control equations. The primary exceptions are the output terms which are always enabled. These are for the critical emergency loads that are energized if any power is available.

The load management modifier format is illustrated in Figure 20. As shown, sixteen management states are provided for load control. One of the sixteen states is active at all times and control the load action during that state by the following criteria:

- o Management character = N: Output equation is solved normally and the associated load controller state is set based on the equation solution.
- o Management character = S: Solution of output equation is skipped and the last state of the output is maintained. The load controller state is set based on the previous output state.
- o Management character = 0: The output equation is forced to a logic "0". The associated load controller is turned off and the load deenergized.
- o Management character = 1: The output equation is forced to a logic "1". The associated load controller is turned on and the load energized.

As previously stated each load (i.e., load controller) has an associated load management modifier. The total load connected to the power generating-conversion equipment is therefore limited to the sum of all loads which have a management character of N, S or 1 in the specific management level or state in effect. This is illustrated by the following example for four loads which have control equations of:

	15	14	13	12	MANAGEMENT STATE LEVELS		
W = A, M(N	0	1	0	.	.	.) (load = 2KW)
W = B, M(N	0	0	0	.	.	.) (load = 1KW)
W = C, M(0	N	1	0	.	.	.) (load = .6KW)
W = D, M(N	N	0	1	.	.	.) (load = .2KW)

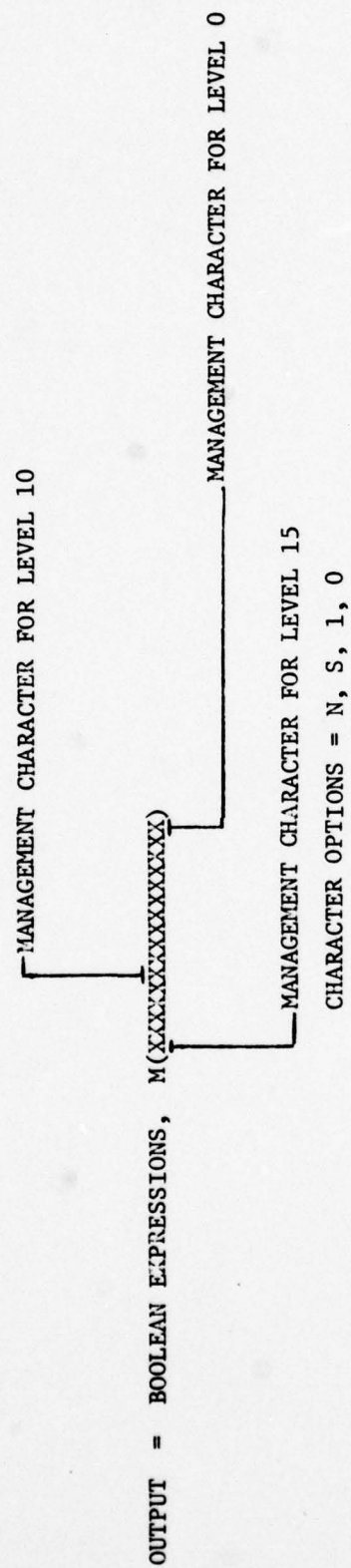


FIGURE 20 LOAD MANAGEMENT MODIFIER FORMAT

If management level 15 is selected and A, B, C and D are a logic 1, then the total load connected is 3.2 kilowatts; should the management state shift from level 15 to level 14, the connected load is reduced from 3.2 KW to 0.2 KW. If A, B, C and D are a logic 0, the connected load is zero for management levels 15 and 14, 2.6KW for level 13, and 0.2KW for level 12. In this manner, the total power demand on the main power buses can be adjusted by changing management states.

The second load management data set consists of equations which define management level selection.

Appendix C contains the preliminary equations which will be used to establish the management levels. Contained in the equations are terms which are functions of the aircraft flight mode, the PGS operational "health" state and the bus priority level. These equations will require refinement as more detailed or complete definition of the PGS health status functions and response characteristics become available. However, the equations as defined are illustrative of the control variables, time constants and management level operation. To the extent that PGS health signals are not available for automatically indicating the generator-power conditioner operational status, manually activated signal sources installed on the General Purpose Signal Source Panels can be used to simulate status. This will exercise the load management "load shedding" and "load addition" operation of the SCG but will not provide an effective evaluation-demonstration of the use of PGS sensed health parameters and associated PGS response characteristics.

Exercise of the load management operation will be somewhat limited during the initial simulator evaluation phase because of the lack of sufficient ADM hardware (SCG terminals and power controllers). The supplementary loading concept described in paragraph 2.3.2 however, minimizes this limitation. This can be accomplished by assigning load management modifiers to the supplementary loads. In this manner sufficient load changes can be made to occur during management level transitions to noticeably impact the generator-converter loading and consequently their level of performance.

Another factor which limits or perhaps complicates the load management operation on the simulator results from the power generation/conversion subsystem design. The PGS subsystem is being designed as basically a 45 kilowatt, dual channel, main system with no emergency power sources. In addition, the generators and converters can be operated in either a split synchronized or parallel mode. In either of these modes, load management will not typically initiate load shedding until the sum of the "present generating capacity" of both generators is less than the connected load. Since a dual channel system is typically designed so that either channel can power all connected loads, both generators would have to degrade to the point where the total generating capacity is less than 45 kilowatts. Therefore, load management will be exercised on the simulator only to the extent that supplementary loading on the main buses can increase the system load above 45 kilowatts.

The simulator design also includes provisions for a second PGS operational mode. In the second mode or alternate configuration, one channel serves as the main power source while the second channel serves as the emergency generator. Although this arrangement distorts the ratio of emergency power capacity to main power capacity, the impact and operation of power source switchover and load management can be evaluated for the single engine implementation. It is noted that for a "typical" single channel system having load management, the main power source load is reduced as a function of its "capacity to generate power". At the point where the degraded capacity of the main channel drops below the capacity available from the emergency source, the main source is disconnected (tripped) and the emergency source is brought

on line. The single channel system load centers (LMC) also typically contain an essential bus and a non-essential bus. The essential sub-bus is powered from the main and the emergency sources. However, the non-essential bus is powered only from the main source. When the main source trips and the emergency source is activated, the connected load drops by virtue of only the LMC essential bus being powered. In this case, the load management software will sense an underload on the emergency generator (main generator tripped). This will result in loads being added until the underload condition load is removed or until all emergency loads are enabled. The number of effective load management levels is doubled as a result of powering only the loads connected to the hardwired essential buses. Since the simulator is being designed for a limited quantity of load controllers and for dual channel operation, it is not practical to split the LMC buses between essential and non-essential. Therefore, the initial simulator design will in effect not employ a split (essential and non-essential) bus.

In order to address both the single channel and dual channel power system operating modes, the management level selection equations in Appendix C contain terms which modify the load management operation as a function of system operation mode. These terms appear in the overload and underload equations of Tables C-2 and C-3 and in the level modifier equations of Table C-5. These additional terms are derived from three cockpit mounted signal sources:

- (a) Load Management Enable,
- (b) Emergency Generator, and
- (c) Single/Dual Channel Mode

Table 11 contains a matrix which illustrates the load management operating mode for the various states of the three signal sources. This enables the load management routine to be exercised with the available simulator loads for both the dual channel and the single channel power system arrangement.

2.5 Avionic Multiplex System Definition

The Avionic Multiplex System (AMUX) provides data communication between the six avionic primary subsystems and seven secondary subsystems as listed in Tables 12-a and 12-b. The signals selected for multiplexing on the data bus represent a cross section of signal types and characteristics. Table 13 indicates the assignment of these signals to the four area multiplex terminals (AMTs). Given in Table 12 are the subsystem name, nomenclature and part numbers, and the location of equipment used in the signal list. The signal assignment list identifies the signal name and identification number, origin and destination, and the general characteristics of each signal. Tables 13-a through 13-d are the assignments for the forward cockpit, aft cockpit, right avionics and left avionics terminals respectively. The candidate signals to be multiplexed are made up of 154 inputs and 178 outputs. Table 14 identifies the signal counts assigned to each terminal.

TABLE 11

LOAD MANAGEMENT OPERATING MODES

LOAD MANAGEMENT TRANSDUCER	EMERGENCY GENERATOR TRANSDUCER	SINGLE/DUAL CHANNEL TRANSDUCER	
		SINGLE CHANNEL	DUAL CHANNEL
ON	OFF CRUISE TAKE-OFF OR LANDING	BUS PRIORITY SELECTION AND FLIGHT PROFILE DETERMINES THE MANAGEMENT LEVEL AND THE ASSOCIATED CONNECTED LOAD.	
OFF	OFF	MANAGEMENT LEVEL 1 SELECT	LOAD MANAGEMENT LEVEL 15 IS SELECTED FOR NORMAL OPERATION (I.E., ALL LOADS ENABLED.)
	CRUISE	MANAGEMENT LEVEL FORCED TO LEVEL 4 OR 8.	
	TAKE-OFF OR LANDING	MANAGEMENT LEVEL FORCED TO LEVEL 9.	

TABLE 12
AVIONIC SYSTEMS MULTIPLEXED

(a) Primary Subsystems Interfaced

<u>NO. OF UNITS</u>	<u>SUBSYSTEM NAME</u>	<u>PART NUMBER</u>	<u>LOCATION</u>
	RADAR ALTIMETER (APN-194)		
1	Receiver Transmitter	RT-1042/APN-194	RC
2	Indicator	ID-1760A/APN-194	INST (Fwd and Aft)
1	Interference Blanker	MX-9132A/APN-194	RC
	DIGITAL DATA COMMUNICATION (ASW-25)		
1	SINS/Waypoints Receptacle	MS3120E16-8S	LWW
1	Converter Receiver	CV-2230/ASW-25	RME
1	Coupler Converter	CU-1923/ASW-25	AMO
2	SINS/Waypoint Switch	215-21209-3	LCSL (Fwd and Aft)
2	Control	C-7100A/ASW-25	LCSL (Fwd and Aft)
	TACAN (ARN-84)		
1	Receiver Transmitter	RT-1022/ARN-84	RA
2	Control	C-9054/ARN-84	RCSL (Fwd and Aft)
1	Mount	MT-4354/ARN-84	RA
1	Antenna Switching Unit	SA-521A/A	RA
	IFF TRANSPONDER (APX-72)		
1	Receiver Transmitter	RT-859A/APX-72	RA
1*	Control	C6200A/APX	LCSL (Fwd and Aft)
1	MK XII Computer	KIT-1A/TSEC	RA
1	Tester	TS-1843B/APX	RA
	UHF RADIO SET (ARC-159)		
2	Receiver Transmitter	RT-1150/ARC-159	RA
2	Control	C-9577/ARC-159	LCSL (Fwd and Aft)
2	Frequency Indicator	ID-1972/ARC-159	INST (Fwd and Aft)
	AUTOMATIC DIRECTION FINDER (ARA-50)		
2	Control	C-1457/ARR-40	LCSL
1	Antenna	AS-909/ARA-48	CD
1	Amplifier Relay	AM-3624/ARA-50	RA
1	Receiver	R-1286/ARR-69	RA

* IFF Control will not be incorporated in aft cockpit.

TABLE 12

AVIONIC SYSTEMS MULTIPLEXED(b) Secondary Subsystems Interfaced

<u>NO. OF UNITS</u>	<u>SUBSYSTEM NAME</u>	<u>PART NUMBER</u>	<u>LOCATION</u>
	HEAD-UP DISPLAY (AVQ-7)		
1	Signal Data Processor	CP-915/AVQ-7	LA
	NAV/WEP DELIVERY COMPUTER (ASN-91)		
1	NWDC	CP-952/ASN	LA
	INERTIAL MEASUREMENT SYSTEM (ASN-90)		
1	Adapter Power Supply	PP-6141/ASN-90	LA
	FORWARD LOOKING RADAR		
1	Sweep Generator	SG-811/APO-126	LME
	INTERCOMMUNICATION SET (AIC-25)		
1	Tone Generator	O-1595/A	RA
	AUTOMATIC FLIGHT CONTROL SYSTEM		
1	Roll Control Amplifier	AM-4353/ASW-26	LA
	HEADING MODE SYSTEM		
2	Attitude Director Indicator	ID-1329/A	INST
2	Horizontal Situation Indicator	ID-1013/A	INST

ASSIGNMENT OF SIGNALS TO BE MULTIPLEXED

TABLE 13a FWD COCKPIT AMT 1

SIGNAL NUMBER	NAME	M	UNIT	FROM	LOC	UNIT	TO	LOC	TYPE	VOLTAGE	UPDATE PATE Q
INPUTS TO RA/IND											
21001	INDICATOR ALT		RA/RT		RC	RA/IND		INST	DC ANA	+ 25 VDC,OV	5 14
21003	SELF TEST		RA/RT		RC	RA/IND		INST	DISC	GROUND/OPEN	5 1
INPUTS TO HMS/HSI											
45011	RNG FLAG CONT		TAC/MT		RA	HMS/HSI		INST	DISC	GROUND/OPEN	5 1
45012	DISTANCE UNITS		TAC/MT		RA	HMS/HSI		INST	SYNCHR	11.8 VAC,OV	5 7
45013	DISTANCE TENS		TAC/MT		RA	HMS/HSI		INST	SYNCHR	11.8 VAC,OV	5 7
45014	DISTANCE HUNDS		TAC/MT		RA	HMS/HSI		INST	SYNCHR	11.8 VAC,OV	5 7
45015	TACAN BEARING		TAC/MT		RA	HMS/HSI		INST	SYNCHR	11.8 VAC,OV	5 13
45016	COURSE DEVIAT		TAC/MT		RA	HMS/HSI		INST	DC ANA	+/-200 MVDC	5 12
45017	RPG FLAG		TAC/MT		RA	HMS/HSI		INST	DISC	+380 MVDC,OV	5 1
45018	TO/FROM		TAC/MT		RA	HMS/HSI		INST	DC ANA	+/-300 MVDC	5 12
45019	CRS RSILVEP ROT		TAC/MT		RA	HMS/HSI		INST	SYNCHR	26 VAC,OV	5 13
INPUTS TO HMS/ADI											
35011	EL STEERING		DDC/CR		RME	HMS/ADI		INST	DC ANA	+/- 2.2VDC	25 8
35034	LATERAL ERROR		DDC/CR		RME	HMS/ADI		INST	DC ANA	+/- 2.2VDC	25 8
OUTPUTS FROM DDC/S-W											
35004	WAYPOINTS		DDC/S-W		LCSL	DDC/RECPT		LWW	DISC	+ 28 VDC,OPEN	5 1

TABLE 13a (cont)

SIGNAL NUMBER	NAME	M	UNIT	FROM	LOC	UNIT	TO	LOC	TYPE	VOLTAGE	UPDATE RATE	0
OUTPUTS FROM DDC/CONT												
35017	ANTI-JAM			DDC/CONT	LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35018	EXT. SELECT			DDC/CONT	LCSL	DDC/CR		RME	DISC	+ 28 VDC,OV	5	1
35019	FREQ SEL 0.1			DDC/CONT	LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35020	FREQ SEL 0.2			DDC/CONT	LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35021	FREQ SEL 0.4			DDC/CONT	LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35022	FREQ SEL 0.8			DDC/CONT	LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35023	FREQ SEL 1.0			DDC/CONT	LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35024	FREQ SEL 2.0			DDC/CONT	LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35025	FREQ SEL 3.0			DDC/CONT	LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35026	FREQ SEL 4.0			DDC/CONT	LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35027	FREQ SEL 10.0			DDC/CONT	LCSL	DDC/CR		PME	DISC	+ 5 VDC,OV	5	1
35028	FREQ SEL 20.0			DDC/CONT	LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
73010	D/L TEST			DDC/CONT	LCSL	DDC/CR		RME	DISC	+ 28 VDC,OV	5	1
OUTPUTS FROM IFF/CONT												
46001	SENSITIVITY CNT			IFF/CONT	LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46002	MODE 3/A ENABL			IFF/CONT	LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46003	MODE 2 ENABL			IFF/CONT	LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46004	MODE C ENABL			IFF/CONT	LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46005	MODE 1 ENABL			IFF/CONT	LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46006	STBY CONTROL			IFF/CONT	LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46007	EMERGENCY CNT			IFF/CONT	LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46008	PWR RELAY CNT			IFF/CONT	LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46009	MOD 4 L-BND DI			IFF/CONT	LCSL	IFF/COMP		PA	DISC	GROUND/OPEN	5	1
46010	IDENT CONTROL			IFF/CONT	LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46016	MODE 1 TEST			IFF/CONT	LCSL	IFF/TSTR		RA	DISC	GROUND/OPEN	5	1
46017	MODE 2 TEST			IFF/CONT	LCSL	IFF/TSTR		RA	DISC	GROUND/OPEN	5	1
46018	MODE 3/A TEST			IFF/CONT	LCSL	IFF/TSTR		RA	DISC	GROUND/OPEN	5	1
46019	MODE C TEST			IFF/CONT	LCSL	IFF/TSTR		RA	DISC	GROUND/OPEN	5	1
46021	AUDIO ENABL			IFF/CONT	LCSL	IFF/TSTR		RA	DISC	GROUND/OPEN	5	1
46022	MCNITOF CNTPL			IFF/CONT	LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46023	TST MODE CNTHL			IFF/CONT	LCSL	IFF/TSTR		RA	DISC	GROUND/OPEN	5	1
46024	MODE 4 TEST			IFF/CONT	LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46030	MODE 1 A1 ENAB			IFF/CONT	LCSL	IFF/COMP		RA	DISC	GROUND/OPEN	5	1
46031	MODE 1 A2 ENAB			IFF/CONT	LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1

TABLE 13a(cont)

SIGNAL NUMBER	NAME	M	UNIT	FROM	LOC	UNIT	TO	LOC	TYPE	VOLTAGE	UPDATE RATE	0
46032	MODE 1 A4 ENAB		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46033	MODE 1 P1 ENAB		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46034	MODE 1 B2 ENAB		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46035	MODE 3/A A1 EN		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46036	MODE 3/A A2 EN		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46037	MODE 3/A A4 EN		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46038	MODE 3/A B1 EN		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46039	MODE 3/A B2 EN		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46040	MODE 3/A R4 EN		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46041	MODE 3/A C1 EN		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46042	MODE 3/A C2 EN		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46043	MODE 3/A C4 EN		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46044	MODE 3/A D1 EN		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46045	MODE 3/A D2 EN		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46046	MODE 3/A D4 EN		IFF/CONT		LCSL	IFF/RT		RA	DISC	GROUND/OPEN	5	1
46047	MODE 4 CDD B E		IFF/CONT		LCSL	IFF/COMP		RA	DISC	GROUND/OPEN	5	1
46048	MODE 4 CDD HLD		IFF/CONT		LCSL	IFF/COMP		RA	DISC	+ 28 VDC, OPEN	5	1
46049	MODE 4 ZEROIZE		IFF/CONT		LCSL	IFF/COMP		RA	DISC	GROUND/OPEN	5	1
INPUTS TO IFF/CONT												
46015	TST LAMP ENAB		IFF/TSTM		RA	IFF/CONT		LCSL	DISC	+ 28 VDC, OPEN	5	1
46020	REPLY LIGHT EN		IFF/RT		RA	IFF/CONT		LCSL	DISC	+ 28 VDC, OPEN	5	1
OUTPUTS FROM TAC/CONT												
45001	TURN ON CMD		TAC/CONT		RCSL	TAC/MT		RA	DISC	GROUND/OPEN	5	1
45002	TST CMD/STATUS		TAC/CONT		RCSL	TAC/MT		RA	DISC	+ 28 VDC, OPEN	5	1
45004	MUX SERIAL DATA		TAC/CONT		RCSL	TAC/MT		RA	S DIG	+ 28 VDC, OV	32	32

TABLE 13a(cont)

SIGNAL NUMBER	NAME	M	FROM UNIT LOC	TO UNIT LOC	TYPE SIGNAL	VOLTAGE	UPDATE RATE
OUTPUTS FROM UHF/CONT 1a							
81001	DATA HI/LO		UHF/CONT 1a LCSL	UHF/RT 1 RA	S DIG	+2, -8	5
81003	PWR ON/OFF				DISC	GROUND/OPEN	24
81004	GRD RCVR ON/OFF					GROUND/OPEN	1
81005	tone XMIT CONT					GROUND/OPEN	1
81006	SQUELCH					GROUND/OPEN	1
81007	ADF ENABLE 1				DISC	GROUND/OPEN	1
81001	DATA HI/LO				S DIG	+2, -8	24
81001	DATA HI/LO				S DIG	+2, -8	24
81001	DATA HI/LO		UHF/CONT 1a LCSL	UHF/CONT 1b LCSL	S DIG	+2, -8	5
INPUTS TO UHF/CONT 1a							
81002	CLOCK HI/LO		UHF/RT 1 RA	UHF/CONT 1a LCSL	S DIG	+2, -8	800
81008	TAKE CONTROL		SCG/PROC LA	UHF/CONT 1a LCSL	DISC	GROUND/OPEN	5
81001	DATA HI/LO		UHF/CONT 1b LCSL	UHF/CONT 1a LCSL	S DIG	+2, -8	5
OUTPUTS FROM UHF/CONT 2a							
81011	DATA HI/LO		UHF/CONT 2a LCSL	UHF/RT 2 RA	S DIG	+2, -8	5
81013	PWR ON/OFF				DISC	GROUND/OPEN	24
81014	GRD RCVR ON/OFF					GROUND/OPEN	1
81015	tone XMIT CONT					GROUND/OPEN	1
81016	SQUELCH					GROUND/OPEN	1
81017	ADF ENABLE 2				DISC	GROUND/OPEN	1
81011	DATA HI/LO				S DIG	+2, -8	24
81011	DATA HI/LO				S DIG	+2, -8	24
81011	DATA HI/LO				S DIG	+2, -8	5
81017	ADF ENABLE 2		UHF/CONT 2a LCSL	ANT/SW RA	S DIG	+2, -8	5
INPUTS TO UHF/CONT 2a							
81012	CLOCK HI/LO		UHF/RT2 RA	UHF/CONT 2a LCSL	S DIG	+2, -8	800
81017	TAKE CONTROL		SCG/PROC LA	UHF/CONT 2a LCSL	DISC	GROUND/OPEN	5
81011	DATA HI/LO		UHF/CONT 2b LCSL	UHF/CONT 2a LCSL	S DIG	+2, -8	5

ASSIGNMENT OF SIGNALS TO BE MULTIPLEXED

TABLE 13b APT COCKPIT AMT 2

SIGNAL NUMBER	NAME	M	UNIT	FROM	LOC	UNIT	TO	LOC	TYPE	VOLTAGE	UPDATE RATE	Q
INPUTS TO RA/INO												
21001	INDICATOR ALT		RA/RT		RC	RA/INO		INST	DC ANA	+ 25 VDC,OV	5	14
21003	SELF TEST		RA/RT		RC	RA/INO		INST	DISC	GROUND/OPEN	5	1
INPUTS TO HMS/HSI												
45011	RNG FLAG CONT		TAC/MT		RA	HMS/HSI		INST	DISC	GROUND/OPEN	5	1
45012	DISTANCE UNITS		TAC/MT		RA	HMS/HSI		INST	SYNCHR	11.8 VAC,OV	5	7
45013	DISTANCE TENS		TAC/MT		RA	HMS/HSI		INST	SYNCHR	11.8 VAC,OV	5	7
45014	DISTANCE HUNDOS		TAC/MT		RA	HMS/HSI		INST	SYNCHR	11.8 VAC,OV	5	7
45015	TACAN BEARING		TAC/MT		RA	HMS/HSI		INST	SYNCHR	11.8 VAC,OV	5	13
45016	CCURSE DEVIAT		TAC/MT		RA	HMS/HSI		INST	DC ANA	+/-200 MVDC	5	12
45017	BPG FLAG		TAC/MT		RA	HMS/HSI		INST	DISC	+380 MVDC,OV	5	1
45018	TO/FROM		TAC/MT		RA	HMS/HSI		INST	DC ANA	+/-300 MVDC	5	12
45019	CRS PSIVER ROT		TAC/MT		RA	HMS/HSI		INST	SYNCHR	26 VAC,OV	5	13
INPUTS TO HMS/ADI												
35011	EI STEERING		DDC/CR		RME	HMS/ADI		INST	DC ANA	+/- 2.2VDC	25	8
35034	LATERAL ERROR		DDC/CR		RME	HMS/ADI		INST	DC ANA	+/- 2.2VDC	25	8
OUTPUTS FROM DDC/S-N												
35004	WAYPOINTS		DDC/S-N		LCSL	DDC/RECPT		LWW	DISC	+ 28 VDC,OPEN	5	1
OUTPUTS FROM DDC/CONT												
35017	ANTI-JAM		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35018	EXT. SELECT		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35019	FREQ SEL 0.1		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35020	FREQ SEL 0.2		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35021	FREQ SEL 0.4		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35022	FREQ SEL 0.8		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35023	FREQ SEL 1.0		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35024	FREQ SEL 2.0		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35025	FREQ SEL 3.0		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35026	FREQ SEL 4.0		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35027	FREQ SEL 10.0		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
35028	FREQ SEL 20.0		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 5 VDC,OV	5	1
73010	D/L TEST		DDC/CONT		LCSL	DDC/CR		RME	DISC	+ 28 VDC,OV	5	1

TABLE 13b (Cont'd)

SIGNAL NUMBER	NAME	M	FROM UNIT LOC	TO UNIT LOC	TYPE SIGNAL	VOLTAGE	UPDATE RATE
OUTPUTS FROM UHF/CONT 1b							
81001	DATA HI/LO		UHF/CONT 1b LCSL	UHF/RT 1 RA	S DIG	+2, -8	5
81003	PWR ON/OFF				DISC	GROUND/OPEN	24
81004	GRD RCVR ON/OFF					GROUND/OPEN	1
81005	TOXN XMIT CONT					GROUND/OPEN	1
81006	SQUELCH					GROUND/OPEN	1
81007	ADF ENABLE 1			UHF/RT 2 RA	DISC	GROUND/OPEN	1
81001	DATA HI/LO			ADF/AMP			
81001	DATA HI/LO			UHF/IND 1 INST	S DIG	+2, -8	24
81001	DATA HI/LO			UHF/IND 2 INST	S DIG	+2, -8	24
81001	DATA HI/LO		UHF/CONT 1b LCSL	UHF/CONT 1a LCSL	S DIG	+2, -8	24
INPUTS TO UHF/CONT 1b							
81002	CLOCK HI/LO		UHF/RT 1 RA	UHF/CONT 1b LCSL	S DIG	+2, -8	800
81007	TAKE CONTROL		SCG/PROC LA	UHF/CONT 1b LCSL	DISC	GROUND/OPEN	5
81001	DATA HI/LO		UHF/CONT 1a LA	UHF/CONT 1b LCSL	S DIG	+2, -8	5
OUTPUTS FROM UHF/CONT 2b							
81011	DATA HI/LO		UHF/CONT 2b LCSL	UHF/RT 2 RA	S DIG	+2, -8	5
81013	PWR ON/OFF				DISC	GROUND/OPEN	24
81014	GRD RCVR ON/OFF					GROUND/OPEN	1
81015	TOXN XMIT CONT					GROUND/OPEN	1
81016	SQUELCH					GROUND/OPEN	1
81017	ADF ENABLE 2			UHF/RT 2 RA	DISC	GROUND/OPEN	1
81011	DATA HI/LO			ADF/AMP			
81011	DATA HI/LO			UHF/IND 1 INST	S DIG	+2, -8	24
81011	DATA HI/LO			UHF/IND 2 INST	S DIG	+2, -8	24
81011	DATA HI/LO			UHF/CONT 2a LCSL	S DIG	+2, -8	24
81017	ADF ENABLE 2		UHF/CONT 2b LCSL	ANT/SW RA	DISC	GROUND/OPEN	5
INPUTS TO UHF/CONT 2b							
81012	CLOCK HI/LO		UHF/RT 2 RA	UHF/CONT 2b LCSL	S DIG	+2, -8	800
81018	TAKE CONTROL		SCG/PROC LA	UHF/CONT 2b LCSL	DISC	GROUND/OPEN	5
81011	DATA HI/LO		UHF/CONT 2a LCSL	UHF/CONT 2b LCSL	S DIG	+2, -8	5

TABLE 13b (cont)

SIGNAL NUMBER	NAME	FROM UNIT	LOC	UNIT	TO	LOC	TYPE	VOLTAGE	UPDATE RATE
OUTPUTS FROM TAC/CONT									
45001	TURN ON CMD	TAC/CONT	RCSL	TAC/MT		RA	DISC	GROUND/OPEN	5 1
45002	TST CMD/STATUS	TAC/CONT	RCSL	TAC/MT		RA	DISC	+ 28 VDC, OPEN	5 1
45004	MUX SERIAL DATA	TAC/CONT	PCSL	TAC/MT		PA	S DIG	+ 28 VDC, OV	32 32
SIGNAL NUMBER	NAME	FROM UNIT	LOC	UNIT	TO	LOC	TYPE	VOLTAGE	UPDATE RATE
OUTPUTS FROM FLR/SG									
72023	ALT DATA XFER	FLR/SG	LME	RA/PT		RC	DISC	GROUND/OPEN	5 1
INPUTS TO FLR/SG									
21005	RELIABILITY	RA/RT	RC	FLR/SG		LME	DISC	+ 5 VDC, OV	25 1
21006	LINEAR ALT	RA/RT	RC	FLR/SG		LME	DC ANA	+ 25 VDC, OV	25 12
21009	LINEAR ALT	RA/RT	RC	FLR/SG		LME	DC ANA	+ 25 VDC, OV	25 12
OUTPUTS FROM ODC/CC									
35013	ODC DATA READY	ODC/CC	AMD	NVDC		LA	S DIG	+ 5 VDC, OV	100 1
35014	ODC DATA	ODC/CC	AMD	NVDC		LA	S DIG	+ 5 VDC, OV	100 20
35015	ODC ADDRESS	ODC/CC	AMD	NVDC		LA	S DIG	+ 5 VDC, OV	100 20
INPUTS TO ODC/CC									
11032	ADC/ODC TEST	NVDC	LA	ODC/CC		AMD	DISC	+ 28 VDC, OV	5 1
11064	DATA CLOCK	NVDC	LA	ODC/CC		AMD	S DIG	+ 5 VDC, OV	50K 1
35009	DATA LINK DATA	ODC/CR	RHE	ODC/CC		AMD	P DIG	+ 12 VDC, OV	14 42
35010	DATA LINK RDY	ODC/CR	RHE	ODC/CC		AMD	S DIG	+ 12 VDC, OV	14 1

ASSIGNMENT OF SIGNALS TO BE MULTIPLEXED

TABLE 13c RIGHT AVIONICS AMT 3

SIGNAL NUMBER	NAME	M	UNIT	FROM	LOC	UNIT	TO	LOC	TYPE	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM TAC/MT												
45007	TAC SERIAL DTA		TAC/MT	RA		NWDC		LA	S DIG	+ 5 VDC,OV	5	20
45011	RNG FLAG CONT		TAC/MT	RA		HMS/HSI		INST	DISC	GROUND/OPEN	5	1
45012	DISTANCE UNITS		TAC/MT	RA		HMS/HSI		INST	SYNCHR	11.8 VAC,OV	5	7
45013	DISTANCE TENS		TAC/MT	RA		HMS/HSI		INST	SYNCHR	11.8 VAC,OV	5	7
45014	DISTANCE HUNDOS		TAC/MT	RA		HMS/HSI		INST	SYNCHR	11.8 VAC,OV	5	7
45015	TACAN HEARING		TAC/MT	RA		HMS/HSI		INST	SYNCHR	11.8 VAC,OV	5	13
45016	COURSE DEVIAT		TAC/MT	RA		HMS/HSI		INST	DC ANA	+/-200 MVDC	5	12
45017	BFG FLAG		TAC/MT	RA		HMS/HSI		INST	DISC	+380 MVDC,OV	5	1
45018	TQ/FROM		TAC/MT	RA		HMS/HSI		INST	DC ANA	+/-300 MVDC	5	12
45019	CPS RSIVER ROT		TAC/MT	RA		HMS/HSI		INST	SYNCHR	26 VAC,OV	5	13
INPUTS TO TAC/MT												
11010	ADDRESS LINE R		NWDC	LA		TAC/MT		RA	S DIG	+ 5 VDC,OV	5	1
11011	READ ADDR LINE		NWDC	LA		TAC/MT		RA	S DIG	+ 5 VDC,OV	5	1
11012	SHIFT CLGCK		NWDC	LA		TAC/MT		RA	S DIG	+ 5 VDC,OV	1M	1
12063	MAG HEADING		IMS/APS	LA		TAC/PI		RA	SYNCHR	11.8 VAC,OV	5	13
45001	TUPN ON CMO		TAC/CONT	RCSL		TAC/MT		RA	DISC	GROUND/OPEN	5	1
45002	TST CMD/STATUS		TAC/CONT	RCSL		TAC/MT		RA	DISC	+ 28 VDC,OPEN	5	1
45004	PUX SEPIL DATA		TAC/CONT	RCSL		TAC/MT		RA	S DIG	+ 28 VDC,OV	32	32
INPUTS TO AMT/SW												
81017	ADF ENABLE 2		UHF/CONT 2a	LCSL		ANT/SW		RA	DISC	GROUND/OPEN	5	1
81017	ADF ENABLE 2		UHF/CONT 2b	LCSL		ANT/SW		RA	DISC	GROUND/OPEN	5	1
INPUTS TO ADF/ANT												
81007	ADF ENABLE 1		UHF/CONT 1a	LCSL		ADF/ANT		RA	DISC	GROUND/OPEN	5	1
81007	ADF ENABLE 1		UHF/CONT 1b	LCSL		ADF/ANT		RA	DISC	GROUND/OPEN	5	1
81017	ADF ENABLE 2		UHF/CONT 2a	LCSL		ADF/ANT		RA	DISC	GROUND/OPEN	5	1
81017	ADF ENABLE 2		UHF/CONT 2b	LCSL		ADF/ANT		RA	DISC	GROUND/OPEN	5	1

TABLE 13c (cont)

SIGNAL NUMBER	NAME	M	UNIT	FROM LOC	TO UNIT	LOC	TYPE	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM IFF/RT										
46020	REPLY LIGHT	EN	IFF/RT	RA	IFF/CGMT	LCSL	DISC	+ 28 VDC, OPEN	5	1
INPUTS TO IFF/RT										
46001	SENSITIVITY CNT		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46002	MODE 3/A ENABL		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46003	MODE 2 ENABL		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46004	MODE C ENABL		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46005	MODE 1 ENABL		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46006	STRY CONTROL		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46007	EMERGENCY CNT		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46008	PWF RELAY CNT		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46010	IDENT CCNTROL		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46021	AUTO ENABL		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46023	TST MODE CNTRL		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46030	MODE 1 A1 ENAB		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46031	MODE 1 A2 ENAB		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46032	MODE 1 A4 ENAB		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46033	MODE 1 B1 ENAB		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46034	MODE 1 B2 ENAB		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46035	MODE 3/A A1 EN		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46036	MODE 3/A A2 EN		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46037	MODE 3/A A4 EN		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46038	MODE 3/A B1 EN		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46039	MODE 3/A B2 EN		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46040	MODE 3/A B4 EN		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46041	MODE 3/A C1 EN		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46042	MODE 3/A C2 EN		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46043	MODE 3/A C4 EN		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46044	MODE 3/A D1 EN		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46045	MODE 3/A D2 EN		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
46046	MODE 3/A D4 EN		IFF/CONT	LCSL	IFF/RT	PA	DISC	GROUND/OPEN	5	1
OUTPUTS FROM IFF/COMP										
73026	IFF ADV SIGNAL		IFF/COMP	RA	SCG/PROC	LA	DISC	+ 28 VDC, OPEN	5	1
INPUTS TO IFF/COMP										
46009	MOD 4 L-BND DI		IFF/CONT	LCSL	IFF/COMP	RA	DISC	GROUND/OPEN	5	1
46024	MODE 4 TEST		IFF/CONT	LCSL	IFF/COMP	RA	DISC	GROUND/OPEN	5	1
46047	MODE 4 CDD B E		IFF/CONT	LCSL	IFF/COMP	RA	DISC	GROUND/OPEN	5	1
46048	MODE 4 CDD HLD		IFF/CONT	LCSL	IFF/COMP	RA	DISC	+ 28 VDC, OPEN	5	1
46049	MODE 4 ZEROIZE		IFF/CONT	LCSL	IFF/COMP	RA	DISC	GROUND/OPEN	5	1
OUTPUTS FROM IFF/TSTR										
* 46015	TST LAMP ENABL		IFF/TSTR	RA	IFF/CONT	LCSL	DISC	+ 28 VDC, OPEN	5	1

TABLE 13c (cont)

SIGNAL NUMBER	NAME	M	FROM UNIT LOC	TO UNIT LOC	TYPE SIGNAL	VOLTAGE	UPDATE RATE
OUTPUTS FROM UHF/RT 1							
81002	CLOCK HI/LO		UHF/RT 1	UHF/CONT 1a	S DIG	+2, -8	800 NA
81002	CLOCK HI/LO		UHF/RT 1	UHF/CONT 1b		+2, -8	800 NA
81002	CLOCK HI/LO		UHF/RT 1	UHF/IND 1		+2, -8	800 NA
81002	CLOCK HI/LO		UHF/RT 1	UHF/IND 2	S DIG	+2, -8	800 NA
INPUTS TO UHF/RT 1							
81003	PWR ON/OFF		UHF/CONT 1a	UHF/RT 1	DISC	0,28	5 1
81004	GRD RCVR ON/OFF					0,28	5 1
81005	tone XMIT CONT					0,12	5 1
81006	SQUELCH					0,12	5 1
81001	DATA HI/LO		UHF/CONT 1a	UHF/RT 1	S DIG	+2, -8	5 24
81003	PWR ON/OFF		UHF/CONT 1b	UHF/RT 1	DISC	0,28	5 1
81004	GRD RCVR ON/OFF					0,28	5 1
81005	tone XMIT CONT					0,12	5 1
81006	SQUELCH					0,12	5 1
81001	DATA HI/LO		UHF/CONT 1b	UHF/RT 1	S DIG	+2, -8	5 24
81009	KEY XMIT 1		UHF/SA	UHF/RT 1	DISC	GROUND/OPEN	5 1
OUTPUTS FROM UHF/RT 2							
81012	CLOCK HI/LO		UHF/RT 2	UHF/CONT 2a	S DIG	+2, -8	800 NA
81012	CLOCK HI/LO		UHF/RT 2	UHF/CONT 2b		+2, -8	800 NA
81012	CLOCK HI/LO		UHF/RT 2	UHF/IND 1		+2, -8	800 NA
81012	CLOCK HI/LO		UHF/RT 2	UHF/IND 2	S DIG	+2, -8	800 NA
INPUTS TO UHF/RT 2							
81013	PWR ON/OFF		UHF/CONT 2a	UHF/RT 2	DISC	0,28	5 1
81014	GRD RCVR ON/OFF					0,28	5 1
81015	tone XMIT CONT					0,12	5 1
81016	SQUELCH					0,12	5 1
81011	DATA HI/LO		UHF/CONT 2a	UHF/RT 2	S DIG	+2, -8	5 24
81013	PWR ON/OFF		UHF/CONT 2b	UHF/RT 2	DISC	0,28	5 1
81014	GRD RCVR ON/OFF					0,28	5 1
81015	tone XMIT CONT					0,12	5 1
81016	SQUELCH					0,12	5 1
81011	DATA HI/LO		UHF/CONT 2b	UHF/RT 2	S DIG	+2, -8	5 24
81019	KEY XMIT 2		UHF/SA	UHF/RT 2	DISC	GROUND/OPEN	5 1

TABLE 13c(cont)

SIGNAL NUMBER	NAME	M	UNIT	FROM	LOC	UNIT	TO	LOC	TYPE	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM ODC/CR												
35009	DATA LINK DATA		ODC/CR		RME	DDC/CC		AMO	P DIG	+ 12 VDC,OV	14	42
35010	DATA LINK PDY		ODC/CR		RME	DDC/CC		AMO	S DIG	+ 12 VDC,OV	14	1
35011	EL STEERING		ODC/CR		RME	HMS/ADI		INST	DC ANA	+/- 2.2VDC	25	8
35012	EL STEERING		ODC/CR		RME	HUD/SDP		LA	DC ANA	+/- 2.2VDC	25	8
35029	ROLL DISPLACE		ODC/CR		RME	AFCSP/PCA		LA	DC ANA	26 VAC,OV	14	10
35030	PITCH DISPLACE		ODC/CR		RME	AFCSP/PCA		LA	AC ANA	26 VAC,OV	14	10
35031	GOOD DATA		ODC/CR		RME	AFCSP/PCA		LA	DI SC	GROUND/OPEN	5	1
35032	GOOD DATA		ODC/CR		RME	AFCSP/PCA		LA	DI SC	GROUND/OPEN	5	1
35033	LATERAL ERROR		ODC/CR		RME	HUD/SDP		LA	DC ANA	+/- 2.2VDC	25	8
35034	LATERAL ERROR		ODC/CR		RME	HMS/ADI		INST	DC ANA	+/- 2.2VDC	25	8
INPUTS TO ODC/CR												
35007	SINS/UMPTS DATA		DDC/RECP		LWW	DDC/CR		RME	S DIG	+/- 5 VDC	63	80
35017	ANTI-JAM		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 5 VDC,OV	5	1
35018	EXT. SELECT		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 28 VDC,OV	5	1
35019	FREQ SEL 0.1		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 5 VDC,OV	5	1
35020	FREQ SEL 0.2		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 5 VDC,OV	5	1
35021	FREQ SEL 0.4		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 5 VDC,OV	5	1
35022	FREQ SEL 0.8		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 5 VDC,OV	5	1
35023	FREQ SEL 1.0		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 5 VDC,OV	5	1
35024	FREQ SEL 2.0		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 5 VDC,OV	5	1
35025	FREQ SEL 3.0		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 5 VDC,OV	5	1
35026	FREQ SEL 4.0		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 5 VDC,OV	5	1
35027	FREQ SEL 10.0		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 5 VDC,OV	5	1
35028	FREQ SEL 20.0		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 5 VDC,OV	5	1
73010	O/L TEST		DDC/CONT		LC SL	DDC/CR		RME	DI SC	+ 28 VDC,OV	5	1
INPUTS TO IFF/TSTR												
46016	MODE 1 TEST		IFF/CONT		LC SL	IFF/TSTR		PA	DI SC	GROUND/OPEN	5	1
46017	MODE 2 TEST		IFF/CONT		LC SL	IFF/TSTR		PA	DI SC	GROUND/OPEN	5	1
46018	MODE 3/A TEST		IFF/CONT		LC SL	IFF/TSTR		PA	DI SC	GROUND/OPEN	5	1
46019	MODE C TEST		IFF/CONT		LC SL	IFF/TSTR		PA	DI SC	GROUND/OPEN	5	1
46022	MONITOR CNTRL		IFF/CONT		LC SL	IFF/TSTR		PA	DI SC	GROUND/OPEN	5	1
OUTPUTS FROM PA/RT												
21001	INDICATOR ALT		PA/RT		RC	RA/IND		INST	DC ANA	+ 25 VDC,OV	5	14
21003	SELF TEST		PA/RT		RC	RA/IND		INST	DI SC	GROUND/OPEN	5	1
21005	RELIABILITY		PA/RT		RC	FLR/SG		LME	DI SC	+ 5 VDC,OV	25	1
21006	LINEAR ALT		PA/RT		RC	FLR/SG		LME	DC ANA	+ 25 VDC,OV	25	12
21007	LINEAR ALT		PA/RT		RC	NWDC		LA	DC ANA	+ 25 VDC,OV	25	12
21008	LINEAR ALT		PA/RT		RC	HUD/SDP		LA	DC ANA	+ 25 VDC,OV	25	12
21009	LINEAR ALT		PA/RT		PC	FLR/SG		LME	DC ANA	+ 25 VDC,OV	25	12
INPUTS TO RA/RT												
72023	ALT DATA XFER		FLR/SG		LME	PA/RT		RC	DI SC	GROUND/OPEN	5	1
OUTPUTS FROM RA/IB												
21011	TRANS BLANKER		RA/IB		RC	SCC/PROC		LA	DI SC	GROUND/OPEN	5	1

ASSIGNMENT OF SIGNALS TO BE MULTIPLEXED

TABLE 13dLEFT AVIONICS AMT 4

SIGNAL NUMBER	NAME	M	UNIT	FROM	LOC	UNIT	TO	LOC	TYPE	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM NWDC												
11010	ADDRESS LINE B	NWDC		LA		TAC/MT		RA	S DIG	+ 5	VDC,OV	5 1
11011	READ ADDR LINE	NWDC		LA		TAC/MT		RA	S DIG	+ 5	VDC,OV	5 1
11012	SHIFT CLOCK	NWDC		LA		TAC/MT		RA	S DIG	+ 5	VDC,OV	1M 1
11032	ADC/DDC TEST	NWDC		LA		DDC/CC		AMD	DISC	+ 28	VDC,OV	5 1
11064	DATA CLOCK	NWDC		LA		DDC/CC		AMD	S DIG	+ 5	VDC,OV	50K 1
INPUTS TO NWDC												
21007	LINEAR ALT	RA/RT		RC		NWDC		LA	DC ANA	+ 25	VDC,OV	25 12
35013	DDC DATA READY	DDC/CC		AMD		NWDC		LA	S DIG	+ 5	VDC,OV	100 1
35014	DDC DATA	DDC/CC		AMD		NWDC		LA	S DIG	+ 5	VDC,OV	100 20
35015	DDC ADDRESS	DDC/CC		AMD		NWDC		LA	S DIG	+ 5	VDC,OV	100 20
45007	TAC SEPTAL DTA	TAC/MT		RA		NWDC		LA	S DIG	+ 5	VDC,OV	5 20
OUTPUTS FROM IMS/APS												
12063	MAG HEADING	IMS/APS		LA		TAC/MT		RA	SYNCH	11.8	VAC,OV	5 13
INPUTS TO HUD/SDP												
21008	LINEAR ALT	RA/RT		RC		HUD/SDP		LA	DC ANA	+ 25	VDC,OV	25 12
35012	EL STEERING	DDC/CR		RME		HUD/SDP		LA	DC ANA	+/- 2.2VDC		25 8
35033	LATERAL EPROR	DDC/CR		RME		HUD/SDP		LA	DC ANA	+/- 2.2VDC		25 8
INPUTS TO AFCS/RCA												
35029	ROLL DISPLACE	DDC/CR		RME		AFCS/RCA		LA	DC ANA	26	VAC,OV	14 10
35032	G000 DATA	DDC/CR		RME		AFCS/RCA		LA	DISC	GROUND/OPEN		5 1
OUTPUTS FROM DDC/RECPT												
35007	SINS/WPTS DATA	DDC/RECPT		LWW		DDC/CR		RME	S DIG	+/- 5	VDC	63 80
INPUTS TO DDC/RECPT												
35004	WAYPOINTS	DDC/S-W		LCSL		DDC/RECPT		LWW	DISC	+ 28	VDC,OPEN	5 1

TABLE 131 (cont)

SIGNAL NUMBER	NAME	M	FROM		TO		TYPE SIGNAL	VOLTAGE	UPDATE RATE	Q
INPUTS TO UHF/IND 1										
81001	DATA HI/LO		UHF/CONT 1a	LCSL	UHF/IND 1	INST	S DIG	+2, -8	5	24
81001	DATA HI/LO		UHF/CONT 1b					+2, -8	5	24
81011	DATA HI/LO		UHF/CONT 2a					+2, -8	5	24
81011	DATA HI/LO		UHF/CONT 2b					+2, -8	5	24
81002	CLOCK HI/LO		UHF/RT 1					+2, -8	800	NA
81012	CLOCK HI/LO		UHF/RT 2	LCSL	UHF/IND 1	INST	S DIG	+2, -8	900	NA
INPUTS TO UHF/IND 2										
81001	DATA HI/LO		UHF/CONT 1a	LCSL	UHF/IND 2	INST	S DIG	+2, 08	5	24
81001	DATA HI/LO		UHF/CONT 1b					+2, 08		
81011	DATA HI/LO		UHF/CONT 2a					+2, -8	5	24
81011	DATA HI/LO		UHF/CONT 2b					+2, -8	800	NA
81002	CLOCK HI/LO		UHF/RT 1					+2, -8	800	NA
81012	CLOCK HI/LO		UHF/RT 2	LCSL	UHF/IND 2	INST	S DIG	+2, -8	800	NA
OUTPUTS FROM SCG/PROC										
81008	TAKE CONTROL		SCG/PROC	LA	UHF/CONT 1a	LCSL	DISC	GROUND/OPEN	5	1
81008	TAKE CONTROL				UHF/CONT 1b					
81018	TAKE CONTROL				UHF/CONT 2a	LCSL			5	1
81018	TAKE CONTROL				UHF/CONT 2b				5	1
73026	IFF ADV SIG		SCG/PROC	LA	IFF/COMP	RA	DISC	+28 VDC/OPEN	5	1

TABLE 14

AMUX TERMINAL-SIGNAL ASSIGNMENT

<u>Terminal No.</u>	<u>Inputs</u>	<u>Outputs</u>	<u>Total</u>
1	21	74	95
2	26	40	66
3	88	39	127
4	23	12	35
	<hr/>	<hr/>	<hr/>
Total	158	165	323

Although the TA-7C provides for both forward and aft cockpit controls for the IFF transponder, only the forward controls will be handled over the AMUX system. This is basically in keeping with the A-7E aircraft implementation. It is also noted that switching logic is required for a group of 15 avionic discrete signals. Of these, 13 signals are used as control variables in Boolean equations and 2 signals are output controls, i.e., the results of equation solutions. All fifteen signals are transferred between the SCG and AMUX via the data bus interface. It is envisioned that the AMUX bus will be operated in the poll-contention mode, therefore, transfer of the signals will occur upon a "change of state" of the signal(s). However, the AMUX data bus operation and protocol is flexible as a result of the AMT being programmable. Consequently, a range of communication-data transfer schemes can be evaluated.

2.6 Avionic System Priority Assignment

In view of the limited quantity of AAES ADM equipment being procured, the problem of requisitioning some of the GFE used on the TA-7C, and the difficulties and complexity of performing certain system tests and evaluations, a list was prepared for the purpose of establishing priority for the systems and equipment. The list was prepared on the basis of performing test and evaluation on a primary subsystem. Therefore, the equipments comprising that subsystem, other supporting subsystems required or desired, and test equipment needed were assembled into a list, Table 15. The table lists the pertinent part numbers for the various equipment. The table also identifies priorities for implementing and testing/evaluating the various TA-7C avionic subsystems on the AAES simulator based on such factors as complexity, equipment availability, special support equipment requirements, difficulty of testing as a result of requiring special set-up such as hydraulics, radiation, the equipment being classified, etc. The priorities range from 1 to 5 with 1 being the most desirable for implementing on the simulator.

TABLE 15
EQUIPMENT REQUIREMENTS FOR SYSTEMS TESTS

SYSTEM & EQUIPMENT	LTV PART NO.	FSN	OTHER SYS. REQD.	OTHER SYS. DESIRED	TEST EQUIPMENT REQD.	TEST DIFF.	NOTES
<u>TACTICAL COMPUTER SET (AN/ASN-91)</u> Nav/Weapon Delivery Computer NWDC Control Panel Monitor Display Panel	216-37183-14 216-21231-14 220-21203-101	2RH6605004093124GA 2RH6605004933733GA 2RH58950102585391UA	None	U/S } Almost HUD } Demand Radar Altimeter Air Data Computer Angle of Attack	AN/ASN-395A Memory Loader Verifier AN/ASN-478 System Interface T/S	1	
<u>INERTIAL MEASUREMENT SET (AN/ASN-90)</u> Inertial Measurement Unit Adapter Power Supply Control Panel - Pwd. MLI Remote Compass Transmitter	216-37340-7 216-37631-3 216-21355-3 MS25396-1	2RE6605000227893TA 2RE4920001823006GA 2RH6605001042771 2RE6605008335087FZ	Tactical Computer	HUD Heading Mode Sys.	AN/ASN-478 System Interface T/S	1	
<u>DOPPLER RADAR NAVIGATION SET (AN/APN-190)</u> Receiver-Transmitter Control Panel - Pwd. Antenna	216-37629-1 216-21380-1 216-37325-1	2RH5841000978741TA 2RH5841001042900GA 2RH5841001032707TA	Tactical Computer Inertial Measurement	None	AN/ASN-478 System Interface T/S AN/APN-342A Nav T/S	3	Radiation Required.
<u>FORWARD LOOKING RADAR (AN/APN-126)</u> Forward Assembly o Transmitter o Antenna-Receiver o Power Supply o Computer o Mount Digital Scan Converter Fault Locator Range Control Panel Radar Control Panel Indicator-Pwd. Indicator-Aft Antenna Tilt Control Panel Blower Transformer Transformer	T1091/APQ126 AS2272/APQ126 PP6130/APQ126 CP954/APQ126 MT4043/APQ126 220-27121-101 216-27877-1 216-21600-10 216-21143-7 220-21242-101 220-21242-102 220-21186-101 216-27393-4 CVC6070-5 CVC6070-6	2RH58410000017075GA 2RH5841000017066GA 2RE5841000017088 2RH5841000017109GA 2RH5841004776037 2RH5841010262728 2RE5841001096060 2RE5841001105379 2RE5841001105370 2RH5841010253175 2RH5841010258738 Purchase Vought 2RE4140001393429 9N5950001052148 9N5950001052149	Tactical Computer	U/S ADC Radar Altimeter	TS2853C/APN-304 Radar T/S AN/ASN-478 System Interface T/S	3	(Classified equipment. Radiation required.

TABLE 15
EQUIPMENT REQUIREMENTS FOR SYSTEMS TESTS

SYSTEM & EQUIPMENT	LTV PART NO.	FSN	OTHER SYS. REQD.	OTHER SYS. DESIRED	TEST EQUIPMENT REQD.	TEST DIFF.	NOTES
<u>HEAD-UP DISPLAY (AN/APN-7)</u> Display Unit Signal Data Processor Camera HUD Monitor Lateral Accelerometer In Range Indicator HUD Mount	216-21245-32 216-37267-21 220-21201-101 220-21201-102 216-37194-1 CVC2600-7 216-21245-26	2RH6605001507026TA 2RE6605001506499TA 2RH5821010258517UA 2RH5821010258533UA 2RH6615001812469GA 9C6210008796232 2RH6605000416293ATA	Tactical Computer Inertial Measurement	ADC Angle of Attack	None	1	
<u>AIR DATA COMPUTER</u> True Air Speed Ind. Air Data Computer Total Temperature Probe Altitude Ind-Pwd. Altitude Indicator-Aft Mach Inc.	215-21127-1 220-37125-101 215-37152-1 AAU-19/A AAU-19/A 215-21124-3	(On rt slant pnl) 2RH66050010298749 9C6685006781082 2RH6610000863840 2RH6610000863840 2RH6610000504289	None	HUD IFF Tactical Computer	SN565A/ASM AIDS Input T/S AN/ASM-371A ADC System T/S	2	
<u>PROJECTED MAP DISPLAY SET (AN/ASN-99)</u> Project Map Display Signal Data Converter PMDS Transformer	ID-1665/ASN-99 218-37668-4 218-27505-1	2RH6605001507043GA 2RH6605001827544GA 9NS950003508282	Tactical Computer	IFF	None	1	
<u>RADAR ALTIMETER (AN/APN-194)</u> Receiver-Transmitter Indicator-Pwd. Indicator-Aft Antenna-Receiver Antenna-Transmit Interference Blanker	RT-1042/APN-194 ID-1760A/APN-194 ID-1760A/APN-194 AS-1233/APN141 AS-1233/APN141 MS9132A/APN-194	2RH5841001653030WZ 2RH5841001687812WZ (Same as above) 1RM5841000198501 1RM5841000198501 1RM5841001104882WZ	None	Tactical Computer Heads-Up Display	AN/APN-347 Altimeter T/S	2	Radiation Required
<u>ANGLE OF ATTACK</u> Transducer Rudder Pedal Shaker-Aft Rudder Pedal Shaker-Pwd. Indicator-Pwd. Indicator-Aft Approach Lights Indexer-Pwd. Indexer-Aft.	220-27166-101 C15302(83326) C15302(83326) MS28067-2 MS28067-2 MS25318-2 MS25318-3 MS25318-4 MS25317-7 MS25317-7	1RD6610010253196UA 2RH1680000457081GA 2RH1680000457081GA 2RH6610006207888FZ 2RH6610006207888FZ 9C6220009441332 9C6220009441345 9C6220009261311 9N6220001812542 9N6220001812542	None	TACTICAL CO. PUTER HUD	None	1	

TABLE 15
EQUIPMENT REQUIREMENTS FOR SYSTEMS TESTS

SYSTEM & EQUIPMENT	LTV PART NO.	FSN	OTHER SYS. REQD.	OTHER SYS. DESIRED	TEST EQUIPMENT REQD.	TEST DIFF.	NOTES
<u>READING MODE SYSTEM</u>							
Attitude Direction Indicator-Pwd.	NS18028-1	2RH6610009442632FZ		Head-Up Display	T7A383 Line Analyzer (ADI)	2	--
Attitude Direction Indicator-Aft.	NS18028-1	2RH6610009442632FZ					
Horizontal Situation Indicator-Pwd.	NS17869-1	2RE5826009447012GA	Tactical Computer				
Horizontal Situation Indicator-Aft.	NS17869-1	2RE5826009447012GA	Inertial Measurement				
Turn Rate Gyro 1	T751AJB3A	2RH1280002210649GA		TACAN			
Turn Rate Gyro 2	T751AJB3A	2RH1280002210649GA		Auto Direction Finder			
Electronic Switch Demodulator	215-27143-1	2RH5841000429723GA					
DC Amplifier	220-27103-101	2RH6610010241459UA					
<u>STANDBY ATTITUDE INDICATING SYSTEM</u>							
Rate Switching Gyro	NS17399-1	2RH6615009509736FZ	None	None	None	1	--
Vertical Displacement Gyro	GN1169A(30003)	2RH6615009587969FZ					
Attitude Indicator-Pwd.	NS17249-1	1A6610003101407					
Attitude Indicator-Aft.	NS17249-1	1A6610003101407					
<u>AUTOMATIC FLIGHT CONTROL SYSTEM (AN/ASN-26)</u>							
Control-Pwd.	215-21130-1	2RH6615000877443					
Control-Aft.	215-21130-2	2RH6615004113356					
Pitch Control Amplifier	215-37121-24	2RH6615002777204					
Roll Control Amplifier	215-37121-21	2RG6615001108926					
Yaw Control Amplifier	215-37121-18	2RG6615004004257					
Roll Actuator	210-32230-19	2RC1650001791148					
Pitch Actuator	210-32230-20	2RC1650002498983					
Yaw Actuator	210-32230-20	2RC1650002498983					
Running Time Indicator	NS17322-6A	6645009042754					
Lateral Accelerometer	216-37194-1	6615001812469					
Dual Command Coupler	220-37330-101	6615010281932					
Rate Gyro No. 1	215-37128-2	6615008772122					
Rate Gyro No. 2	215-37128-2	6615008772122					
Roll Solenoid Valve	215-32331-1	165000597961					
Pitch Solenoid Valve	215-32331-1	165000597961					
Yaw Solenoid Valve	215-32331-1	165000597961					
AMZ Gain Changer	215-48103-5	590500089527					
AIL-RUD Transducer	215-38104-3	661000956114					
Normal Accelerometer 1	215-37129-2	6615008775925					
Normal Accelerometer 2	215-37129-2	6615008775925					
<u>APPROACH POWER COMPENSATOR (AN/ASN-54)</u>							
Computer	215-37155-3	2RH6615007820895GA					
Servo Actuator	215-47120-1	8RH6615000893084GA					
Servo Amplifier	215-37126-2	8RH6615001217677GA					
UHT Potentiometer	215-48071-1(Simulac)	(Simulac)					
Accelerometer	215-37178-2	1RD6615008801341					
APC Warning Light	CVC2600-9	9G6210001830523					
			Angle of Attack	None	AN/ASN-334 APC T/S	2	--

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VOUGHT CORP DALLAS TEX
AAES LABORATORY SIMULATOR REQUIREMENTS (A-7 AIRCRAFT). (U)
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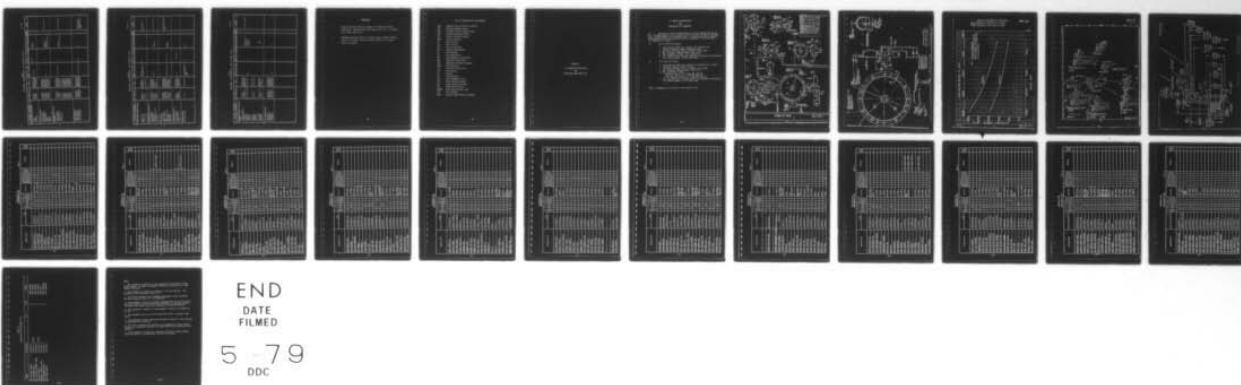


TABLE 15
EQUIPMENT REQUIREMENTS FOR SYSTEMS TESTS

SYSTEM & EQUIPMENT	LTV PART NO.	FSN	OTHER SYS. REQD.	OTHER SYS. DESIRED	TEST EQUIPMENT REQD.	TEST DIFF.	NOTES
<u>APPROACH CONTROL SYSTEM (AN/ARA-63)</u> Receiver Decoder Control-Pwd. Control-Aft.	RL379/ARA63 RT651/ARA63 C7949/ARA63 C7949/ARA63	8RG5826004917513EX 8RH5826004917514EX 8RH5895001688856EX 8RH5895001688856EX	Heading Mode	Data Link	AN/ARW-146 ACS T/S	3	--
<u>RADAR BEACON (AN/APN-154)</u> Control Panel-Pwd. Control Panel-Aft. Receiver-Transmitter KA Band Receiver Antenna 1 Antenna 2 Modulator Duplexer	C4419/APN154 C4419/APN154 RT763/APN154 RL623/APN AS1739A/APN154 AS2406/APR HD817/APN154 CUI104/APN154	2RH5841001687890 2RH5841001687890 2RH5895001108174 2RH5895001687820 1RH5841000706136 2RH5841001687822 2RH5841001687819 1RD584100763060	None	None	AN/APN-230B Radar Beacon T/S SM/658/APM Radar Beacon Simulator	3	Radiation Required.
<u>DIGITAL DATA COMMUNICATION SET (AN/ASW-25)</u> Converter-Receiver Coupler Converter Control Panel-Pwd. Control Panel-Aft. Antenna Data Link Lights	CV2230A/ASW-25 218-27390-1 C7100/ASW-25 C7100/ASW-25 218-77514-1 CVC2600-10 CVC2600-10 CVC2600-11 CVC2601-45 CVC2601-46 CVC2602-35 CVC2602-35 CVC2602-45 CVC2602-45	2RH5895008391404 2RH5895001688358GA 2RH5895001683631 2RH5895001683631 1RD5826001186221 9CG6210001830521 9CG6210001830521 9CG6210001830522 9CG6210001830532 9CG6210001830533 9CG6210001830552 9CG6210001830552 9CG6210001193148 9CG6210001193148	Tactical Computer	None	SM-511/ASW Digital Data Simulator	3	Classified equipment.
<u>UHF RADIO (AN/ARC-159)</u> Control Panel-Pwd. Control Panel-Aft. Receiver-Transmitter Freq. Indicator-Pwd. Freq. Indicator-Aft.	C9815/ARC-159 C9815/ARC-159 RT-1150/ARC-159 ID-1972/ARC-159 ID-1972/ARC-159	8RH5821010213503JZ (Same as above) 8RH5821010184240JZ 8RH5821001401785H2 (Same as above)	Intercommunication Set	None	None	3	Radiation Required. (Alternate FSN 8RH5821001401817H2 for ID-972)

TABLE 15
EQUIPMENT REQUIREMENTS FOR SYSTEMS TESTS

SYSTEM & EQUIPMENT	LTV PART NO.	FSN	OTHER SYS. REQD.	OTHER SYS. DESIRED	TEST EQUIPMENT REQD	TEST DIFF.	NOTES
<u>AUTOMATIC DIRECTION FINDER (AN/ARA-50)</u>							
UHF-1FF Diplexer Antenna Amplifier-Relay Tail Cap Antenna	215-37151-1 AS909/ARA48 AM3624/ARA50 216-60090-4	9N5985000694614 2RH5826008490055 2RH5826000592726 1RD1560001030573	UHF Radio Intercommunications Set Heading Mode System	None	None	3	ADF Station must be available.
<u>INTERCOMMUNICATIONS SET (AN/AIC-25)</u>							
Control Panel-Pwd. Control Panel-Aft. Intercom Station Tone Generator Pilot's Service Disconnect Pilot's Headset Audio Unit	220-21362-101 220-21362-101 C6624/AIC-25 218-37530-1 215-21191-3 (Simulate) 220-27416-105	1RD1680010248762 1RD1680010248762 2RH5831008802833 2RH5821003147836 (Simulate) 2RH5950010274134	UHF Radio	None	TS387U Handphone T/S	2	Audio Source required.
<u>TACAN (AN/ARN-84)</u>							
Control Panel-Pwd. Control Panel-Aft. Receiver-Transmitter Mount Antenna Switching Unit Blower Assembly Lower Antenna Upper Antenna	C9054/ARN-84 C9054/ARN-84 RT1022/ARN-84 HT-4354/ARN-84 SA-521A A018709 (82877) 218-77514-1 CV21-010001-4	1RD5826009480468 1RD5826009480468 8RH5826001688769 T2 8RH5826001688770 T2 5985008370000 1RD44140708786606 1RD5826001186221 1RH5826000899727	Heading Mode System	Tactical Computer	AN-ARN-155 AN-ARN-156	2	(The C2010 panels are an acceptable alternate for C9054.)
<u>1FF TRANSPONDER (AN/APX-72)</u>							
Control Panel-Pwd. Control Panel-Aft. Receiver-Transmitter Tester	C6280/APX C6280/APX RT859A/APX-72 TS1843/APX-72	1RD5895001822980 1RD5895001822980 2RH5895001491319 A2 2RH5895008594446	None	Air Data Computer		2	--
<u>INTERFERENCE BLANKER</u>							
Interference Blanker	216-37162-3	2RH5841001066148	Forward Looking Radar Radar Altimeter TACAN 1FF	None	None	2	--

TABLE 15
EQUIPMENT REQUIREMENTS FOR SYSTEMS TESTS

SYSTEM & EQUIPMENT	LTV PART NO.	FSN	OTHER SYS. REQD.	OTHER SYS. DESIRED	TEST EQUIPMENT REQD.	TEST DIFF.	NOTES
<u>PASSIVE COUNTERMEASURES (AN/ALR-45 and ALR-50)</u>							
45/50 Control Panel	218-21195-3	2RH5865001275166					
Signal Distribution Unit	218-37503-4	2RH5865000011771					
45 Analyzer	TS3053/ALR-45	8RH5865001486059					
45 Indicator	31-011203-01(15280)	2RH5865009892107					
Presamp-45°	31-027824-01(15280)	2RH5865004345409	None	None	AN/ASX-456, 457, 458 High Power RF Simulators. AN/ALM-140 ALR-50 T/S	2	Classified equipment.
Presamp-135°							
Presamp-225°							
Presamp-315°							
50 Receiver							
Antenna-45°	RI764/ALR-50	8RG5865000019653					
Antenna-315°	AS2805/ALR45	1RD5895004345306					
Antenna-225°							
Antenna-125°							
Upper Antenna	AT-141A	9NS985001060906					
Lower Antenna	01-23-03721(15280)	1RD5895001340900					
RRAW Lights	216-21347-11	(Simulate)					
RRAW Lights	CVC2601-44	9C6210001830538					
<u>CHAFF DISPENSER (AN/ALE-29)</u>							
Control Panel	218-21243-2	2RH5895004940781					
Left Sequencer	SA1557/ALE-29A	2RH5895000874212					
Right Sequencer	SA1557/ALE-29A	2RH5895000874212					
Programmer	HX7718/ALE-29A	2RH5865001773417					
Left Dispenser	HX7721/ALE-29A	2RH5865000899754	None	None	None	1	--
Right Dispenser	HX7721/ALE-29A	2RH5865000899754					

REFERENCES

1. Advanced Aircraft Electrical System, A-7E Prototype Design, Final Report NADC-76193-30, dated August 1977, by J. R. Perkins, etal, Vought Corporation.
2. POWERTRAN Reference Manual for Program Support Software Pakcage, Report No. 78-14905, dated 15 February 1978, by W. R. Sobko, Garrett Airesearch.

LIST OF ABBREVIATIONS AND ACRONYMS

AAES	Advanced Aircraft Electrical System
AAS	Advanced Armament System
ACLS	Automatic Carrier Landing System
ADM	Advanced Development Model
AMT	Avionic Multiplex Terminal
AMUX	Avionic Multiplex
BC	Bus Controller
BIT	Built In Test
BTC	Bus Tie Controller
CAD	Computer Aided Design
DT	Data Terminal
EM	Electromechanical
EMI	Electromagnetic Interference
GCU	Generator Control Unit
GFE	Government Furnished Equipment
HVDC	High Voltage DC
ICU	Industrial Control Unit
I/O	Input/Output
KW	Kilowatt
LC	Load Controller
LMC	Load Management Center
PCU	Power Conditioning Unit
PGS	Power Generation System
SCG	SOSTEL Control Group
SOSTEL	Solid State Electric Logic
TBE	To be Defined
VSCF	Variable Speed Constant Frequency

APPENDIX A

**A-7 ENGINE PAD DEFINITION
FOR
INTERFACING HVDC GENERATOR**

A-7 ENGINE PAD DEFINITION
FOR
INTERFACING HVDC GENERATOR

1.0 Enclosed are drive pad definitions for the two engines used on the A-7. The HVDC generator can be suitable mounted on either in terms of available space, overhung moment, and available torque. A suitable gear box is required for attaining the desired speed/rotation for the generator. The drive pads are summarized as follows:

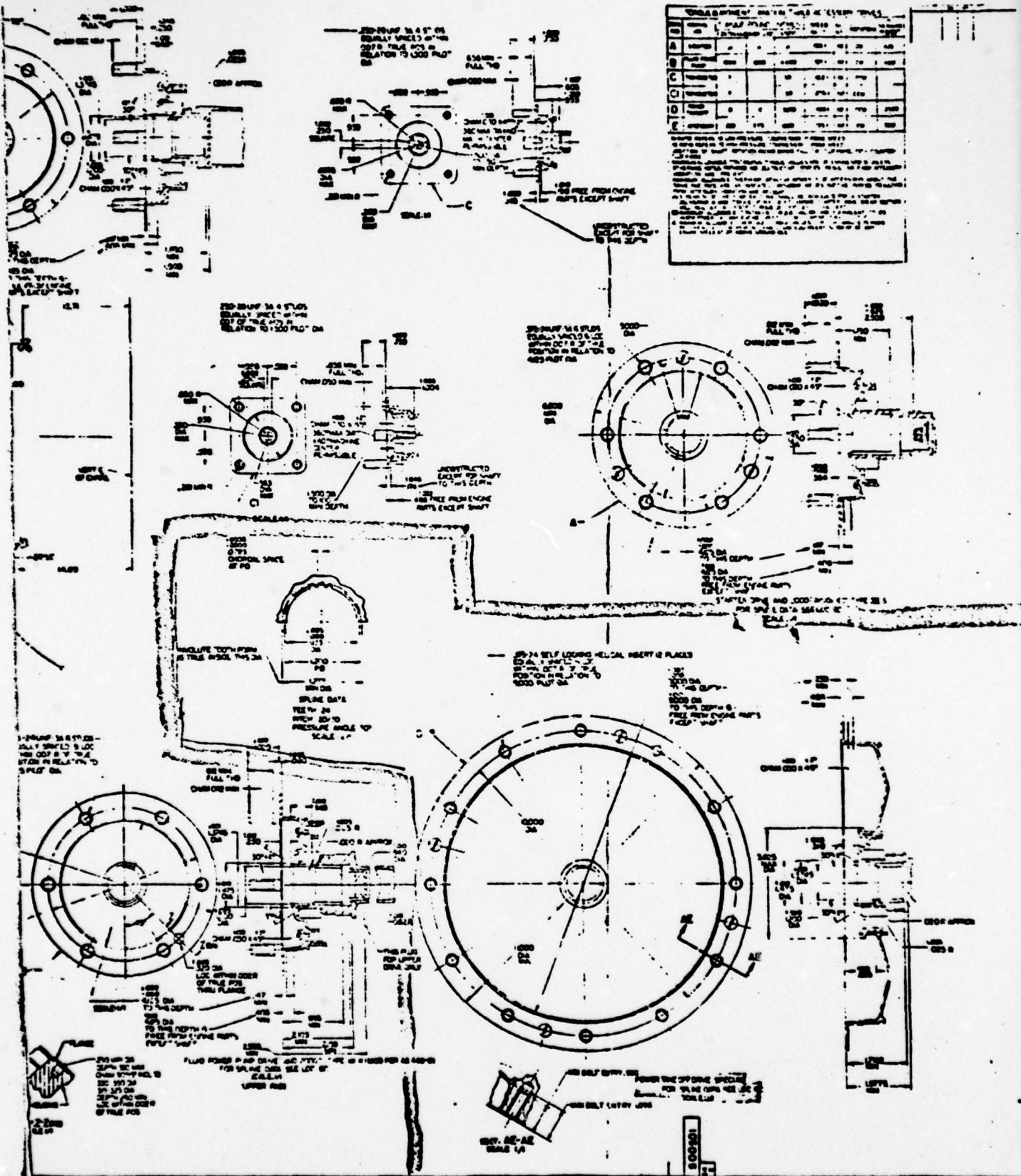
1.1 TA-7C (TF30-P-408 Engine)

- a. Power Take-off (CSD) Pad - Special, see enclosure (1), counter clockwise rotation (looking at pad).
- b. Pad Output RPM Range 4000 to 7500 RPM (.488 N₂ RPM).
- c. Max. allowable overhung moment 2,500 in-lb.
- d. Max. permissible torque, - See Enclosure (2).
- e. Max. available space envelope available for generator installation: 11.0 inches diameter x 24.00 inches long.

1.2 A-7E (TF41-A-2 Engine)

- a. Power Take-off (CSD) Pad - Special, see Enclosure (3), counter clockwise rotation (looking at pad).
- b. Pad Output RPM Range 4074 to 7459 RPM (.574 N₂ RPM).
- c. Max. allowable overhung moment 2,500 in-lb.
- d. Max. permissible torque:
 - Continuous 2354 lb.-in. @ 4074 RPM (152 HP),
 - Continuous 1060 lb.-in. @ 7459 RPM (125 HP).
 - 5 Min. Overlead 3750 lb.-in. @ 4074 RPM (242 HP).
- e. Max. available space envelope available for generator installation: 11.0 inches diameter x 24.0 inches long.

NOTE: Enlargements are provided to show details of pad.



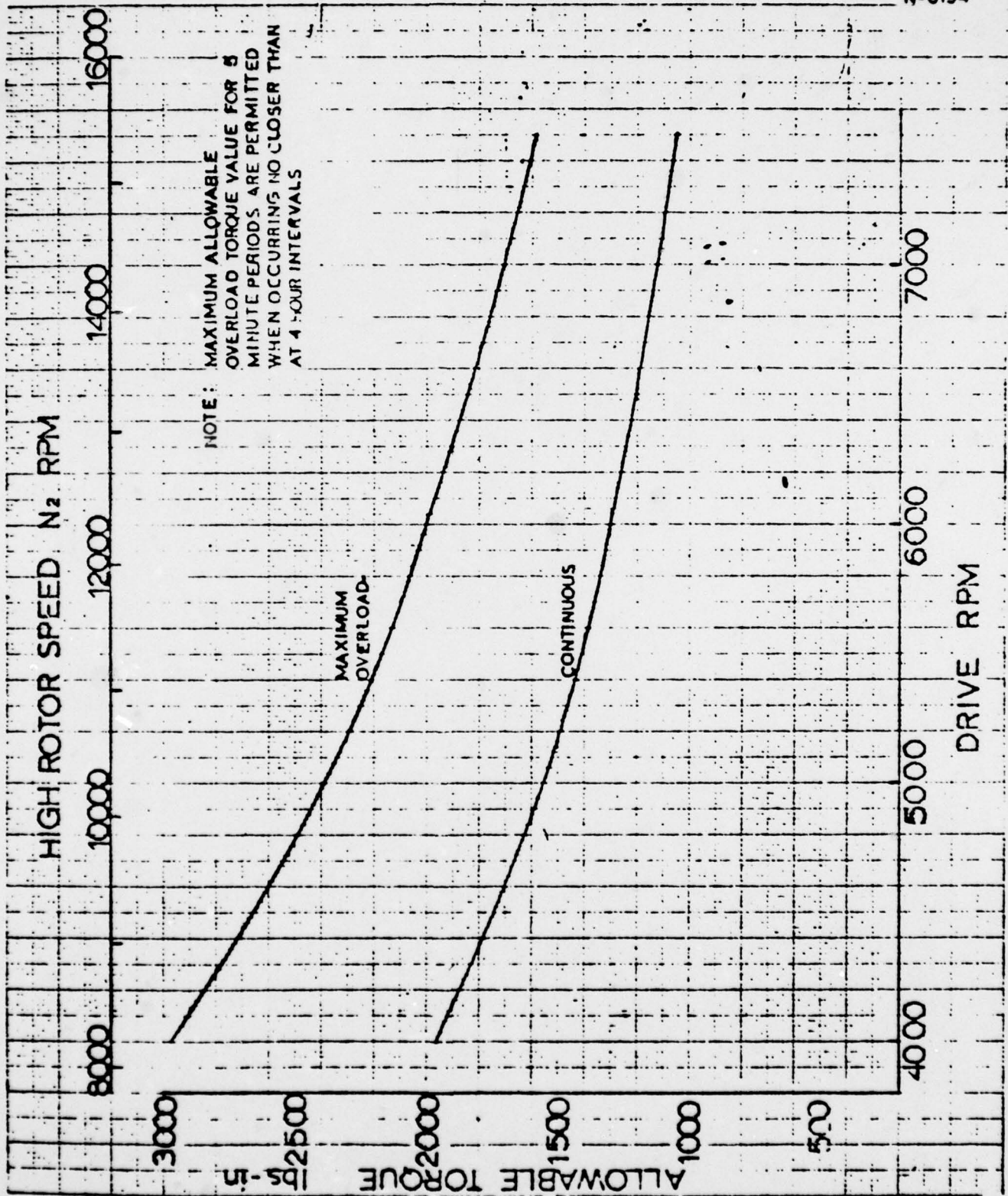
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ENCLOSURE 1
Page 1 of 2

TF30-P-408 TURBOFAN ENGINE
ALLOWABLE TORQUE vs RPM
FOR GENERATOR DRIVE PAD

ENCL (2)

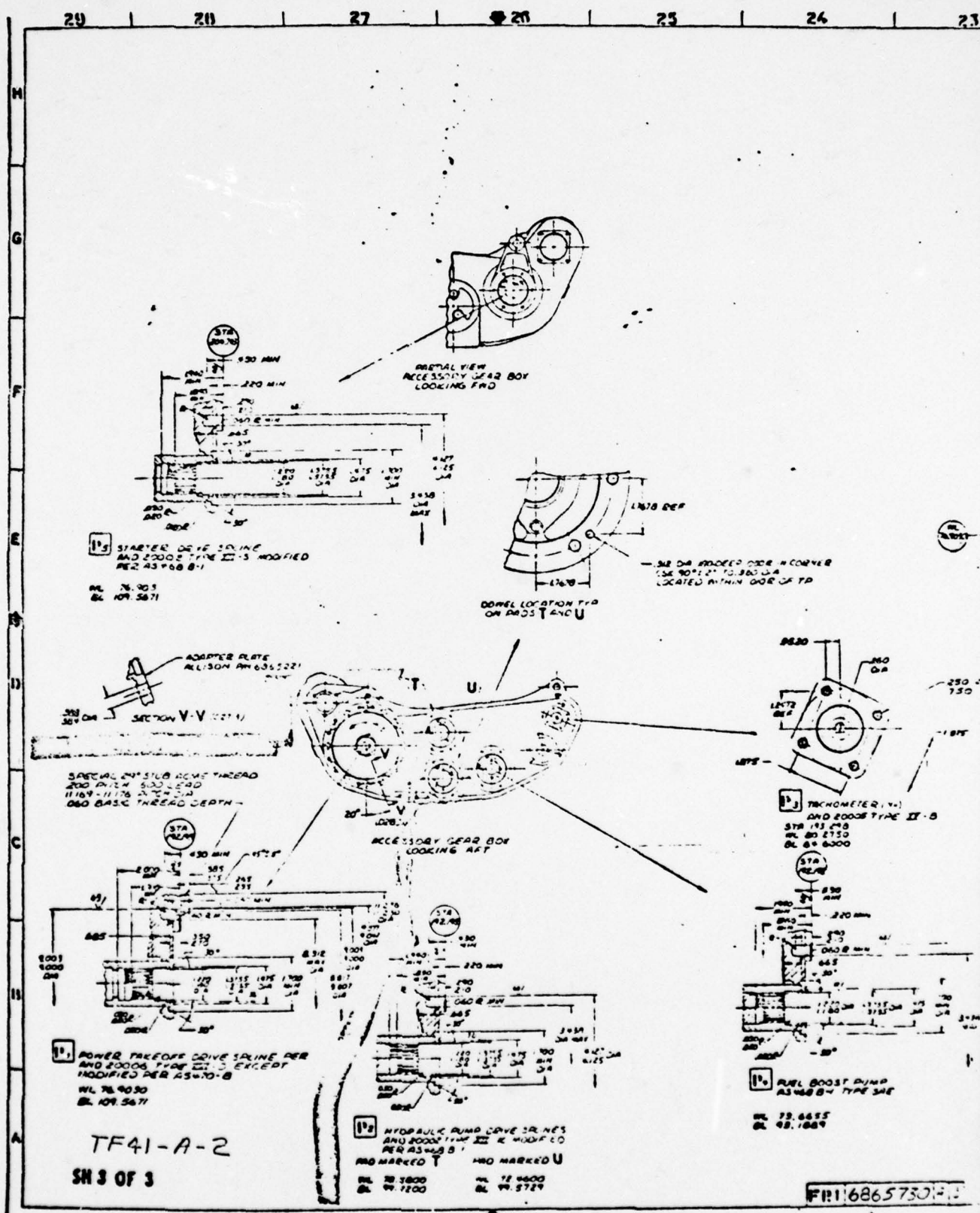
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APPENDIX B
GFE EQUIPMENT LIST

TABLE B-1: SIMULATOR GFE EQUIPMENT LIST

NOMENCLATURE	PART NO. OR SIMILAR TO (#)	VENDOR	GFE	GFE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK UP	OTHER	REMARKS	QUAL TEST REQD
					ADD	REMOVE	REWORK	REPLACE										
SIDS SIG CONDITIONER	CV2529/APG			X	1				L AVIONIC									
DIODE/RESISTOR CARD	220-27182-101		X		1				AMMO CMPT				X					
FWD STICK GRIP	215-21132-3		X		1				FWD COCKPIT				X					
AFT STICK GRIP	215-21132-3		X		1				AFT COCKPIT				X					
ARMT ADV LTS	CVC260X SERIES		X		8				FWD INSTR BD				X					
ARMT ADV LTS	CVC 260X SERIES		X		7				AFT INSTR BD				X					
GUN CONTROL UNIT	216-27209-2		X		1				LOX CMPT									
GUN CMPT PURGE VALVE	215-26106-3		X		1				MID EQUIP									
FUZE FUNC CTL PNL	C-8213/AWW-2B			X	1				LCSL-FWD									
FUZZING PWR SUPPLY	AM4708A/AWW-2A			X	1				L AVIONIC									
CAMERA CONTROL UNIT	LB-17A			X	1				L AVIONIC									
CAMERA	KB-18A			X	1				AFT SHELF									
THROTTLE QUADRANT	220-21241-101		X					1	LCSL-FWD				X					
THROTTLE QUADRANT	220-21241-102		X					1	LCSL-AFT				X					
SPEED BRAKE VALVE	215-32106-3		X		1				AFT SHELF									
WHLS/FLAPS WARN LT	CVC2553-58		X		1				FWD INSTR				X					
WHLS/FLAPS WARN LT	CVC2553-58		X		1				AFT INSTR				X					
FUEL MGMT PNL-FWD	218-21270-3		X					1	LCSL-FWD				X					

**SIMULATOR GFE
EQUIPMENT LIST**

Page 2

NOMENCLATURE	PART NO. OR SIMILAR TO (*)	VENDOR	GFE	GFE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
					ADD	REMOVE	REWORK	REPLACE										
FUEL MGMT PNL-AFT	220-21269		X				1		LCSL-AFT				X					
APC WARNING LIGHT	CVC2600-9		X		2				FWD INSTR BD				X					
ACCEL TRANSDUCER	215-37178-2		X		1				L AVIONIC									
APC COMPUTER	215-37155-3		X		1				L AVIONIC									
APC AMPLIFIER	215-37126-2		X		1				L AVIONIC									
APC ACTUATOR	215-47120-1		X		1				AFT SHELF									
AFT GEN CTL PNL	220-21174-101		X				1		LCSL-FWD				X					
FWD GEN CTL PNL	218-11074-4		X				1		LCSL-AFT				X					
PITCH & ROLL TRIM AMPL	215-37134-4		X		1				L AVIONIC									
ROLL TRIM ACTUATOR	215-38030-5		X		1				AFT SHELF									
PITCH TRIM ACTUATOR	215-68050-3		X		1				AFT SHELF									
T.E. FLAPS CTL VALVE	215-22151-6		X		1				DORSAL									
EMER FLAPS VALVE	215-22106-1		X		1				L MID EQUIP									
L FWD SLANT PNL	218-21261-1		X				1		LCSL-FWD				X					
L AFT SLANT PNL	220-21375-101		X				1		LCSL-AFT				X					
FWD LDG GR HDL	CV21-406052-6		X		1				LCSL FWD				X					
AFT LDG GR HDL	CV21-406052-6		X		1				LCSL-AFT				X					
T.E. FLAPS SYNCHRO	215-77709-1		X		1				DORSAL				X					

SIMULATOR GFE
EQUIPMENT LIST

Page 3

NOMENCLATURE	PART NO. OR SIMILAR TO (#)	VENDOR	GFE	GFE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
					ADD	REMOVE	REWORK	REPLACE										
SPEED BRAKE POS IND	216-21573-1		X		2				FWD & AFT INSTR BD				X					
SPD BRAKE POS SYNCHRO	215-77709-1		X		1				R CHEEK				X					
FUEL QTY IND-FWD	215-21301-1		X		1				FWD INSTR				X					
FUEL QTY IND-AFT	220-21301-101		X		1				AFT INSTR				X					
DOPPLER CTL PNL	216-21380-1			X	1				RCSL-FWD								APN-190 System	
DOPPLER TRANSCIEVER	216-37629-1			X	1				R AVIONIC									
DOPPLER ANTENNA	216-37525-1			X	1				MID EQUIP									
RH PITOT TUBE	856#4 (04274)			X	1				R COCKPIT				X					
STBY ATT IND	MS17249-1			X	2				FWD & AFT COCKPIT				X					
RATE GYRO	MS17399-1			X	1				L AVIONIC				X					
VERTICAL GYRO	CN1169A (30003)			X	1				R AVIONIC				X					
IMS CONTROL	216-21355-3			X	1				RCSL FWD								ASN-90 System	
IM UNIT	216-37340-7			X	1				L AVIONIC									
ADAPT FWR SUPPLY	216-37631-9			X	1				L AVIONIC									
REMOTE COMPASS XMTR	MS25396-1			X	1				AFT EQUIP									
ANGLE OF ATTACK IND	MS28067-2			X	2				FWD & AFT INSTR BD				X					
APPROACH INDEXER	MS25317-7			X	2				FWD & AFT INSTR BD				X					
RUDDER PEDAL SHAFT	CL5302 (83326)		X		2				FWD & AFT COCKPIT				X					

**SIMULATOR CFE
EQUIPMENT LIST**

Page 4

NOMENCLATURE	PART NO. OR SIMILAR TO (#)	VENDOR	CFE	CFE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST RECD
					ADD	REMOVE	REWORK	REPLACE										
APPROACH LTS	MS25318 (-2,-3,-4)		X		3				L DUCT WALL				X					
AOA TRANSDUCER	220-27166-101		X		1				L COCKPIT				X					
RELAY CARDS	216-17411-1		X		6				L AVIONIC				X					
DEMOS SWITCH	215-27143-1		X		1				AFT COCKPIT				X					
ATT DIR IND	MS18028-1			X	2				FWD & AFT INSTR BD									
AIRSPEED IND	215-21124-3		X		1				FWD INSTR BD									
DC AMPLR	220-27105 -101		X		1				AFT COCKPT									
TURN RATE GYRO	MS17394-1			X	2				L AVIONIC									
AFT FLT MODE PNL	220-21271-101		X				1		AFT INSTR BD				X					
IN RANGE INDICATOR	CVC2600-7		X		2				FWD & AFT INSTR BD				X					
HEADS-UP DISPLAY	216-21245-32		X		1				FWD INSTR BD									
HUD ELEC UNIT	218-37267-21		X		1				L AVION									
HUD MOUNT	216-21245-26		X		1				FWD INSTR BD									
LATERAL ACCELEROMETER	216-37194-1		X		1				L AVION									
PROJ MAP DISP UNIT	ID-1665/ASN-99			X	1				FWD INSTR									
PROJ MAP ELEC UNIT	218-37668-4			X	1				R AVION									
PMDS XFMR	218-27505-1		X		1				R AVION									
MWD CONTROL	216-21231-4			X	1				RCSL FWD									

**SIMULATOR GFE
EQUIPMENT LIST**

Page 5

NOMENCLATURE	PART NO. OR SIMILAR TO (#)	VENDOR	GFE	GFE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
					ADD	REMOVE	REWORK	REPLACE										
NWD MONITOR DISP	220-21203-101		X		1				RCSL AFT									
NWD COMPUTER	216-37183-14			X	1				L AVIONIC									
DIG DATA FORMATTER	218-27590-1		X		1				MID EQUIP									
HUD CAMERA	220-21201-101		X		1				FWD INSTR BD									
HUD MONITOR	220-21201-102		X		1				AFT INSTR BD									
ACLS DECODER	KY651/ARA63			X	1				DUCT WALL									
ACLS RCVR	R1379/ARA63			X	1				DUCT WALL									
ACLS CWTN PNL	C7949/ARA63			X	2				FWD & AFT RCSL									
CMD XFER PNL	220-21366-103		X				1		FWD INSTR BD				X					
CMD XFER PNL	220-21366-104		X				1		AFT INSTR BD				X					
HORIZ SIT IND	MS17869-1			X	2				FWD & AFT INSTR BD				X					
WINGFOLD CTL ASSY	215-21222-25		X				1		RCSL FWD				X					
WINGFOLD VALVE	215-32101-1		X		1				MID EQUIP				X					
ARG VALVE	215-32331-1		X		1				AFT SHELF				X					
LGS SELECTOR VALVE	215-32331-1		X		1				MID EQUIP				X					
LAUNCH BAR WARN LT	218-21680-1		X		2				FWD & AFT INSTR BD				X					
LAUNCH BAR VALVE	215-22122-2		X		1				MID EQUIP				X					
HYD ACCUM HTR BLANKT	215-27156-3		X		1				MID EQUIP				X					

**SIMULATOR GFE
EQUIPMENT LIST**

Page 6

NOMENCLATURE	PART NO. OR SIMILAR TO (#)	VENDOR	GFE	GFE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
					ADD	REMOVE	REWORK	REPLACE										
ELECT COMPT FAN	215-36320-2A		X		2				L&R AVIONIC				X					
RED FLD LIGHTS	A9555-2 (72914)		X		17				COCKPIT				X					
WHT FLOOD LIGHTS	A4950A-1 (72914)		X		8				COCKPIT				X					
COCKPIT UTILITY LT	MS17245-5		X		2				COCKPIT				X					
LIGHTING XFMR	CV21-207503-2		X		6				COCKPIT				X					
TRIMMER PANEL	216-27383-26		X		1				COCKPIT				X					
DIMMER FWR SUPPLY	218-27538-1		X		4				COCKPIT				X					
DIMMER FWR SUPPLY	218-27538-4		X		2				COCKPIT				X					
LAND TAXI LIGHT	50-0018 (72914)		X		1				MID EQUIP				X					
UPPER ANTI-COLLISION LT	215-77300-1		X		1				MID EQUIP				X					
FORMATION LT	CV21-407505-1		X		2				MID EQUIP				X					
FORMATION LT	CV21-407505-1		X		2				AFT SHELF				X					
TAIL LT	A6331-1		X		2				AFT SHELF				X					
TAIL LT	B62711-1		X		2				AFT SHELF				X					
MASTER CAUTION LT	210-29276-1		X		2				FWD & AFT INSTR RD				X					
TRIMMER PANEL	216-27383-27		X		1				COCKPIT				X					
SEAT ADJUST ACTUATOR	220-21151-107		X		1				FWD COCKPIT				X					
CAPACITOR ASSY	CP53BFE504V1		X		2				FWD & AFT COCKPIT				X					
SEAT ADJUST ACTUATOR	220-21151-109		X		1				AFT CKPT				X					

**SIMULATOR GFE
EQUIPMENT LIST**

Page 7

NOMENCLATURE	PART NO. OR SIMILAR TO (*)	VENDOR	CPE	GFE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST RECD
					ADD	REMOVE	REWORK	REPLACE										
EPP ACTUATOR VALVE	215-22337-1		X		1				MID EQUIP									
CANOPY ACTUATOR	220-24515-101		X		1				COCKPIT				X					
CANOPY LOCK ACTUATOR	220-24514-102		X		1				COCKPIT				X					
BATTERY, CANOPY	220-27020-103		X		1				MID EQUIP									
BATTERY CHARGER	220-27021-102		X		1				MID EQUIP									
PROBE LIGHT	218-21675-2		X		1				MID EQUIP				X					
PROBE VALVE	215-22330-1		X		1				MID EQUIP				X					
THERMAL SENSOR	215-33308-1		X		2				MID EQUIP				X					
FUEL TRANSFER VALVE	215-43301-1		X		2				AFT SHELF				X					
FUEL DUMP VALVE	AV16B1601		X		2				MID EQUIP				X					
UHF-ADF ANTENNA	216-60090-4			X	1				DUCT WALL									
UHF-ADF AMP-RELAY	AM-3624/ARA-50			X	1				R AVIONIC									
UHF-IFF DUPLXER	215-37151-1			X	1				R AVIONIC									
UHF-IFF ANTENNA	216-60090-4			X	1				AFT-SHELF									
TONE GENERATOR	218-37530		X		1				R AVION									
TACAN CONTROL	C9054/ARN-84			X	2				FWD & AFT RCSL									

SIMULATOR GFE
EQUIPMENT LIST

Page 8

NOMENCLATURE	PART NO. OR SIMILAR TO (*)	VENDOR	CPE	GFE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
					ADD	REMOVE	REWORK	REPLACE										
TACAN MOUNT	MTA35A/ARN84			X	1				R AVION									
TACAN XMTR/RCVR	RTL022/ARN84			X	1				R AVION									
TACAN BLOWER	ROTR-AD-18709		X		1				R AVION									
TACAN COAXIAL SW	SA-521A			X	1				R AVION									
TACAN UPPER ANT	CV21-Q10001-4		X		1				MID EQUIP									
TACAN LOWER ANT	218-77514-1		X		1				MID EQUIP									
DATA LINK DISC LHS	CVC2601 SERIES		X		9				FWD & AFT INSTR BD			X						
DATA LINK CTL	C/100/ASW-25			X	2				FWD & AFT LCSL									
DATA LINK RCVR- CNVTR	CV2230A/ASW-25			X	1				MID EQUIP									
DATA LINK ANTENNA	218-77514-1		X		1				DUCT WALL FWD & AFT									
UHF CHANNEL IND	ID-1972/ARC-159			X	2				INSTR BD									
UHF CONTROL PNL	C9815/ARC-159			X	4				FWD & AFT INSTR BD									
UHF SWITCHING UNIT	220-37455-101		X		1				L AVION									
UHF XMTR RCVR	RTL150/ARC-159			X	2				R AVION									
AUDIO CONTROL PNL	220-21362-101		X				2		FWD & AFT LCSL			X						
AUDIO UNIT	220-27416-105		X		1				MID EQUIP				X					
INTERCOM STATION	C6624/AIC-25			X	1				MID EQUIP									
HEIGHT INDICATOR	ID1760/APN-194			X	1				FWD & AFT INSTR BD									

SIMULATOR GFE
EQUIPMENT LIST

Page 9

NOMENCLATURE	PART NO. OR SIMILAR TO (#)	VENDOR	CPE	GFE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
					ADD	REMOVE	REWORK	REPLACE										
HEIGHT IND RCVR-XMR	RT1042/APN-194			X	1				R AVION									
HEIGHT INTERFERENCE BLANKER	MX9132A/APN-194								R AVION									
HEIGHT IND ANTENNA	/APN-194			X	2				MID EQUIP									
ALTITUDE INDICATOR	AAU-19/A			X	2				FWD & AFT INSTR BD									
RADAR SET	216-27122-8		X		1				NOSE									
RADAR MOUNT	MT-4043/APQ126		X		1				NOSE									
RADAR INDICATOR	220-21242-101		X		1				FWD INSTR BD									
RADAR DIG SCAN CNVR	220-27121-101		X		1				MID EQUIP									
RADAR RANGE CTL	216-21600-10		X		1				FWD INSTR BD									
RADAR CTL PNL	216-21143-7		X		1				FWD LC SL									
RADAR INDICATOR	220-21242-102		X		1				AFT INSTR BD									
RADAR FAULT LOC	216-27877-1		X		1				CAN DECK									
RADAR PWR SUPPLY	PF6130/APQ126		X		1				NOSE									
RADAR BLOWER	216-27393-4		X		1				NOSE									
RADAR XFMR	CVC6070-5		X		1				NOSE				X					
RADAR XFMR	CVC6070-6		X		1				NOSE				X					

**SIMULATOR GFE
EQUIPMENT LIST**

Page 10

NOMENCLATURE	PART NO. OR SIMILAR TO (#)	VENDOR	GFE	GFE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
					ADD	REMOVE	REWORK	REPLACE										
RADAR ANT TILT CTL	220-21186-101		X		1				AFT LCSL									
IFF TRANSPONDER CTL	C-6280/APX			X	2				FWD & AFT LCSL									
IFF TRANSPONDER TESTER	TS-1843/APX-72			X	1				R AVION									
IFF RCVR-XMTR	RT-859/APX-72			X	1				R AVION									
INTERFERENCE BLANKER	216-37162-3		X		1				L AVION									
RHAW CTL PNL	218-21195-3		X		1				FWD RCSL									
RHAW RCVR	RL764/ALR-50			X	1				R AVION									
RHAW ANALYZER	TS3053/ALR-45		X		1				L AVION									
RHAW INTERFACE	218-37503-4		X		1				L AVION									
RHAW ANTENNA	AT-741A		X		1				MID EQUIP									
RHAW ANTENNA	01-23-03721		X		1				MID EQUIP								(CODE IDENT 15280)	
RHAW INDICATOR	31-011203-01		X		1				FWD INSTR BD								(CODE IDENT 15280)	
RHAW PREAMP	31-027824-01		X		4												(CODE IDENT 15280)	
RHAW ANTENNA	AS2605/ALR45		X		2				DUCT WALL									
RHAW ANTENNA	21-027827		X		2				AFT SHELF								(CODE IDENT 15280)	
INTEGRATED ECM PNL	218-21243-2		X		1				FWD RCSL									
PROGRAMMER	MX7718/ALE-29A			X	1				COCKPIT									
CHAFF SEQUENCER	SA1557/ALE29A		X		2				AFT SHELF									

**SIMULATOR GFE
EQUIPMENT LIST**

Page 11

NOMENCLATURE	PART NO. OR SIMILAR TO (*)	VENDOR	GFE	GFE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
					ADD	REMOVE	REWORK	REPLACE										
CHAFF DISPENSER	MX7721/ALE29A			X	2				AFT SHELF									
AIR DATA COMPUTER	220-37125-101		X		1				R AVION									
TEMPERATURE PROBE	215-37152-1		X		1				MID EQUIP				X					
RADAR BEACON RCVR	R1623/APN			X	1				DUCT EQUIP									
RADAR BEACON XMR	RT763/APN154			X	1				DUCT EQUIP									
RADAR BEACON DUPLER	CU-1104/APN154			X	1				DUCT EQUIP									
RADAR BEACON MODULATOR	MD-817/APN154			X	1				DUCT EQUIP									
RADAR BEACON ANTENNA	AS-1739A/APN154			X	1				DUCT EQUIP									
RADAR BEACON CTL PNL	C4419/APN154			X	2				FWD & AFT RCSL									
RADAR BEACON ANTENNA	AS2406/APR			X	1				DUCT EQUIP									
INT-EXT LTS CTL PNL	218-21399-3		X				1		FWD RCSL				X					
INT LTS CTL PNL	220-21299-101		X				1		AFT LCSL				X					
RELAY CARDS	216-17411-1		X		3				ERH U. AMMO				X					
RELAY CARDS	216-17411-1		X		2				L. AVIONIC				X					
RELAY CARDS	216-17411-1		X		3				R. AFT CKPT				X					
PURSE DOOR VALVE	216-32497-1		X		1				MID EQUIP									
HYDRAULIC SOLENOID	216-26205		X		1				MID EQUIP									
GUN RATE VALVE	216-32483-1		X		1				MID EQUIP									

SIMULATOR GFE

EQUIPMENT LIST

Page 12

NOMENCLATURE	PART NO. OR SIMILAR TO	VENDOR	CPE	CPE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
					ADD	REMOVE	REWORK	REPLACE										
ADVISORY LIGHTS PANEL	220-21353-101		X			1			FWD R CSL				X					
ADVISORY LIGHTS PANEL	220-21353-102		X			1			AFT R CSL				X					
HYDRAULIC PRESS XMITTER	216-32499-1		X		2				AFT SHELF									
PRESS RATIO INDICATOR	215-21185-1		X		2				FWD & AFT INSTR BD									
OIL PRESSURE INDICATOR	MS 17996-2		X		1				AFT INSTR BD									
OIL PRESSURE INDICATOR	218-21538-1		X		1				FWD INSTR BD									
FUEL QTY SIM ASSY	216-27361-1		X		1				MID EQUIP									
TACHOMETER INDICATOR	MS 21971-2		X		2				FWD & AFT INSTR BD									
FUEL FLOW INDICATOR	EFU-7/A		X		2				FWD & AFT INSTR BD									
TURBINE INLET TEMP IND	215-21338-1		X		2				FWD & AFT INSTR BD									
PITOT HEATER	856W-1		X		1				COCKPIT									
ACCEL COUNT INDICATOR	MS 25448-1		X		1				AFT SHELF									
ACCEL COUNT TRANSDUCER	MS 25447-7		X		1				AFT SHELF									
ANTI-SKID CONTROL UNIT	218-34251-4		X		1				RH AVION									
ANTI-SKID CONTROL VALVE	216-34251-1		X		1				AFT SHELF									
ANTI-SKID SHUTOFF VALVE	216-32498-1		X		1				AFT SHELF									
BATTERY RELAY ASSY	220-27225-101		X		1				R COCKPIT				X					

SIMULATOR GFE

Page 13

EQUIPMENT LIST

NOMENCLATURE	PART NO. OR SIMILAR TO	VENDOR	CPE	CPE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
					ADD	REMOVE	REWORK	REPLACE										
PARABRAKE CONTROL VALVE	215-22120-2		X		1				AFT SHELF									
EJECTOR VALVE	397690-1-1(99 193)		X		1				R COCKPIT									
RAIN REPELLANT VALVE	MS 29527-1		X		1				"RADAR COMPT"									
ACCUM HEATER BLANKET	215-27156-1		X		1				MID EQUIP									
ACCUM HEATER BLANKET	215-27156-3		X		1				MID EQUIP									
FUEL SHUTOFF VALVE	215-43307-2		X		2				AFT SHELF									
ANTI-COLLISION LIGHT	216-37341-4		X		1				BASE									
WING POSITION LIGHT	215-87300-1		X		1				AFT SHELF									
WING POSITION LIGHT	215-87300-2		X		1				AFT SHELF									
WING FORMATION LIGHT	215-87120-1		X		1				AFT SHELF									
WING FORMATION LIGHT	215-87120-2		X		1				AFT SHELF									
FUSELAGE FORMATION LIGHT	CV21-408505-1		X		2				MID EQUIP									
HYD DUMP SURGE DAMPER	215-22308-1		X		1				AFT SHELF									
HYD ACCUMULATOR	215-22102-8		X		2				MID EQUIP									
HYD ACCUMULATOR	215-22102-10		X		1				MID EQUIP									
HYD ACCUMULATOR	215-22102-11		X		1				MID EQUIP									
FUEL SHUTOFF VALVE	215-73301-1		X		4				AFT SHELF									
THERMAL SENSOR CTL	215-33308-2		X		1				AFT SHELF									

EQUIPMENT LIST

Page 14

[illegible]

TABLE B-2
ADDITIONAL GFE EQUIPMENT LIST

ITEM	PART NUMBER	FSN	NOTE	SYSTEM
CLEARING SOLENOID	11010205 (81840)		1	MG1 GUN
STICK GRIP FORCE SENSOR	215-21129-8		1	AFCS
STICK GRIP FORCE SENSOR	215-21129-8		1	AFCS
MAGNETIC PICK-UP SENSOR	114C2927 (05606)		2	MG1 GUN
FIRE VOLTAGE POINT	216-29126-1		2	MG1 GUN
LAST ROUND SWITCH	13535825 (05606)		2	MG1 GUN
PRESSURE RATIO TRANSDUCER	220-45302-101		5	ENG INSTR
OIL PRESSURE TRANSDUCER	1E1-5/A9HIL-T-25642B		5	ENG INSTR
OIL PRESSURE SWITCH	215-55312-1		5	ENG INSTR
TACHOMETER GENERATOR	GEN-7/A		5	ENG INSTR
FUEL PRESSURE SWITCH	215-53301-1		4	FUEL CONTR
FUEL FLOW TRANSMITTER	TRU-12/A		5	ENG INSTR
WAVEGUIDE	216-37188-2		7	DOPPLER RADAR
WAVEGUIDE	216-37188-1		7	DOPPLER RADAR
WAVEGUIDE	216-37188-4		7	DOPPLER RADAR
WAVEGUIDE	218-27214-2		7	APP CTL LDG
WAVEGUIDE	218-27215-1		7	APP CTL LDG
WAVEGUIDE	218-27213-2		7	APP CTL LDG
ANTENNA	218-27500-1		7	APP CTL LDG
NOSE GEAR STEERING ACTUATOR	215-22130-1		11	NOSE GEAR STR
NOSE GEAR STEERING TRANSDUCER	215-68131-1		11	NOSE GEAR STR
AIR CONDITIONING CONTROL	216-26102-3		14	TEMP CONTROL
CABIN TEMPERATURE SENSOR	216-26119-1		14	TEMP CONTROL
SUIT AIR CONTROL PANEL	218-21257-1		14	TEMP CONTROL

TABLE B-2
ADDITIONAL GFE EQUIPMENT LIST

ITEM	PART NUMBER	FSN	NOTE	SYSTEM
SUIT AIR TEMP SENSOR	216-26119-1		14	TEMP CONTROL
SUIT AIRFLOW VALVE	397420-1-1 (99193)		14	TEMP CONTROL
SUIT AIR FLOW CONTROL PANEL	216-26118-2		14	TEMP CONTROL
CABIN AIR VALVE	397418-1-1 (99193)		14	TEMP CONTROL
HYDRAULIC SOLENOID VALVE	215-21067-1		11	ACCUM TEST
FUEL PRESSURE SWITCH	215-73317-1		4	FUEL TRANSFER
FUEL FLOAT SWITCH	215-73319-1		17	FUEL TRANSFER

NOTES:

1. This equipment is required for full operation of the Automatic Flight Control System. The AFCS was assigned a System Test Difficulty of 5 (the highest difficulty).
2. This equipment is required for operation of the M61 20MM gun. This system has a test difficulty rating of 5+.
3. Use of this equipment will be somewhat meaningless without providing the fluid pressure of which is to be monitored.
4. This equipment is part of the engine instrumentation set and will not be operational without the TF-30 engine which generates the measured condition or without some suitable device for simulating the measured condition.
5. This equipment is required if electromagnetic radiation is attempted in the lab.
6. This equipment will not be fully operational without a hydraulic power source.
7. This equipment requires complicated mechanical hardware to fully evaluate the anti-skid control function.
8. This item is required for operation of the temperature control system. However, air conditioner operation (or installation) is not practical in the simulator.
9. This equipment is required for operation of the fuel transfer system. Since fuel will not be transferred, this item is optional.